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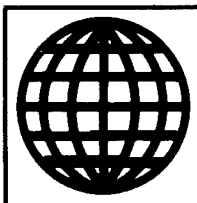

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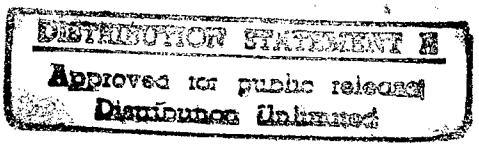

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UDC 771.351.76

Electrically Controlled Objective Lens-Set Unit K35OPF16E

907K0021C Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 9, Sep 89 pp 28-31

[Article by V. N. Maslyakov, Central Design Office for Motion Picture Apparatus, Scientific-Industrial Association EKRAN (Screen)]

[Abstract] The objective lens-set unit K35OPF16E developed in 1984 by EKRAN for 35 mm motion picture cameras includes, in addition to the four-lens variable-focus objective, a handle mountable on top of the camera and containing electrical controls for adjusting the camera and regulating the focal length over the 25-100 mm range. With the free left thumb, moreover, the operator can smoothly regulate the image scale with the necessary speed. The optical system is designed conventionally but laid out for maximum compactness, with a reciprocating mechanism for moving the first lens along the optical axis of the third and fourth ones and with focusing done by moving it along the ocular eyepiece screw. The advantages of this construction are, besides simplicity of assembly and adjustment, bilateral correctibility of the cam and uniform wear of the cam surface. The first lot of 10 units was produced in 1985 and two more experimental units are being now tested in various studios. Figures 5; references 6: Russian.

UDC 772.93.022

Latent Image in "Relief" Electrooptical Light Modulator

907K0106B Moscow ZHURNAL NAUCHNOY I PRIKLADNOY FOTOGRAFII I KINEMATOGRAFII in Russian Vol 34, No 5, Sep-Oct 89 (manuscript date not given) pp 390-396

[Article by Yu. P. Gushcho and V.M. Kartashov]

[Abstract] A general theory proposed to describe formation of a latent image in the "Relief" electrooptical light modulator. First is calculated the electric potential distribution in the deformable dielectric layer on a substrate at zero potential and in the gaseous dielectric interlayer under the upper electrode, the problem having been reduced to a parametric one for the Laplace equation with a coefficient characterizing the degree of charge buildup as parameter and with the appropriate boundary conditions. Next are calculated the electric field intensity at the free surface of the deformable layer and the density of the deforming it surface force, this force having been resolved into its normal and tangential components. The time constant of charge flow across the interface is then calculated in terms of surface and volume charge densities in the two layers (also the surface charge density on the thermoplastic case) and both electric field components, the relief being rarely so deep as to make the time constant dependent on its depth. Amplifi-cation and relaxation of the latent image during dynamic recording are then considered in relation to charge buildup and charge drain respectively, these two processes being rather significant in the usual low-frequency (1 Hz to 100 kHz) mode of modulator operation. Figures 7; references 26.

STV-12 Satellite Television Systems

907K0132 Moscow RADIO in Russian No 11, Nov 89 pp 7-9

[Article by A. Varbanskiy]

[Abstract] The planned configuration of STV-12 Satellite Television Systems in the first ITU region, which includes the USSR and Europe, is described with the aid of maps and tables indicating the zones which satellites operating in the 11.7-12.5 GHz frequency band will cover. Within this 800 MHz wide frequency band will be shared by forty 27 MHz wide FM channels, with a compound modulating signal and a +/-13.5 MHz frequency deviation. High interference immunity will be ensured by clockwise and counterclockwise polarization of waves. Figures 5; tables 2.

FM Receiver for 430 MHz Frequency Band

907K0132B Moscow RADIO in Russian No 11, Nov 89 pp 29-31

[Article by A. Mikhelson (UA6AFL), Krasnodar]

[Abstract] A UHF-FM radio receiver for the 430-440 MHz sports channel is described which features a detector with phase-lock automatic frequency control. Its sensitivity is 0.1 μV at a 10 dB signal-to-noise ratio. Its simple construction is based on the superheterodyne scheme with single frequency conversion, its heterodyne consisting of a 405 MHz oscillator, a 45 MHz quartz oscillator for frequency stabilization, two frequency treblers, one i-f amplifier, and two bandpass filters. The mixer is built on an inverted tunnel diode. The amplifier consists of two identical stages built on a transistor pair each. The synchronous phase detector, built on one transistor, converts the intermediate frequency to audio frequency at the second harmonic of the 12.5-17.5 MHz variable-capacitance L-C tuning circuit. A low-pass filter on demodulates the FM signal and suppresses amplitude modulation, a higher-order additional R-C or L-C filter at the receiver output will further increase the signal-to-noise ratio. Figures 3; references 5.

Restoration of Devices Containing K237GS1 Microcircuit

907K0132C Moscow RADIO in Russian No 11, Nov 89 p 34

[Article by V. Zavyalova, Krivoy Rog, and V. Matveyenko, Veseloye (Zaporozhye Oblast)]

[Abstract] The two radio amateurs submit independently but similar recommendations on how to restore portable

magnetic tape recorders "Vesna" ("Karpaty") models 202 and 205, both containing a K237GS1 microcircuit in the voltage supply stabilizer for the multipurpose amplifier and in the erase-magnetize current generator. When any of the two transistors in either of these two microcircuits fails and no spare K237GS1 microcircuit is readily available, one can replace the bad transistor with a K315 (any suffix letter) transistor. It may be necessary to strip leads and thus gain access to the microcircuit outputs for the unsoldering and resoldering operations.

UDC 621.396.229

Optimization of Asynchronous Systems with Code Division of Users by Combining Use of Pseudonoise Signals with Interference-Immune Encoding

907K0136A Moscow RADIOTEKHNIKA in Russian No 11, Nov 89 (manuscript received, after completion, 21 Jan 88) pp 5-8

[Article by N.I. Smirnov and V.S. Kuznetsov]

[Abstract] Optimization of data transmission systems with code division of users by interference-immune encoding the data in compound signals is proposed, optimum data transmission in asynchronous systems being ensured by a high-speed delay detection and tracking in the information carrying compound signals with phase-lock automatic frequency control using a separate continuously repetitive compound synchronizing signal. The probability of reception error, i.e., of pulse polarity misidentification is calculated for pseudonoise compound signals, taking into account imprecise synchronization, first without and then with interference-immune binary encoding. The number of users calling simultaneously without degrading the reception quality is calculated for various combinations of code parameters (n - length of code combination, k - number of bits in code combination, $d_x = 2t+1$ minimum code distance in Hamming metric, t - maximum multiplicity of errors correctible by given code). The maximum number of simultaneously calling users allowed without the data transmission speed $r = k/n$ dropping below some fixed level and the error probability per bit not rising above some fixed level is shown to be larger with than without interference-immune encoding, the factor by which it increases depending on the error probability per bit. Figures 3; tables 1; references 6.

UDC 621.391.1

Statistical Characteristics of Digital Noncoherent Delay Discriminator for Phase-Shift-Keyed Pseudonoise Signals

907K0127B Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 32, No 11, Nov 89 (manuscript received, after revision, 22 Jun 88) pp 55-58

[Article by V. A. Barkhota and V. V. Gorshkov]

[Abstract] The statistical characteristics of a digital noncoherent delay discriminator for phase-shift-keyed noise-like signals in tracking receivers are evaluated, noncoherent discriminators being used for determining the delay of the keying pseudorandom sequence but a two-channel digital one being particularly suitable for this purpose. At its input appears an additive mixture of a phase-shift-keyed pseudonoise signal with some time delay relative to the reference pseudorandom sequence, the time delay being normalized to the length of one element in that sequence, and a white Gaussian noise with a certain spectral density. Both pass through a band-elimination filter and then through a stiff limiter which lowers the the noise power and forms a bipolar signal of unity amplitude. This signal appears at the inputs of two identical digital correlators, the reference signals to these correlators respectively leading and lagging the bipolar input signal by the length of one pseudorandom sequence element. Each correlator is essentially a digital integrator with reset in the form of a modulo 2 summing device and a reversible counter. The two statistical characteristics of the discriminator output signal, namely the dependence of its mathematical expectation and of its dispersion on the delay of the the discriminator input signal, are respectively the discriminator discrimination and fluctuation characteristics. Both are calculated theoretically on the basis of a constant signal-to-noise ratio during a period of high-frequency duty. A computing device connected to the output of this discriminator alters completely alters both characteristics, as it does those of a coherent digital one, so that only a lag-or-lead indication needs to be picked up from the output of a this noncoherent digital one when the signal-to-noise power ratio is low. Figures 4; references 5.

UDC 621.391.883

Filtration of Periodic Radio Signal Envelope

907K0127C Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 32, No 11, Nov 89 (manuscript received, after revision, 4 Jul 88) pp 63-65

[Article by V. B. Kitayev, Ye. I. Sergeyev, and I. R. Shaynyak]

[Abstract] A filter is synthesized for quasi-optimum maximum-likelihood estimation of a periodic radio signal envelope, adaptive to a changing initial signal phase. The performance of this filter is demonstrated on an additive mixture of a periodic useful signal $S(t)\cos(\omega_0+ \varphi)$ expandable into a Fourier series and a normal white noise n(t) with zero mean, the signal period $T_1= T/N$ and the spectral density of the noise being known. The signal envelope S(t) is also expandable into a Fourier series, its fundamental frequency ω_1 being much lower than ω_0. Estimation of this envelope is shown with the signal phase φ first assumed to be known. The expression for the optimum envelope estimate remains the same when the signal phase φ is unknown and thus becomes an interfering parameter, it now appears as a maximum-likelihood estimate. It may typically be a random quantity with an a priori known probability distribution. The envelope estimation error S(t) - S(t) is most expediently expanded into series of terms which are random functions of time with dispersions proportional to 1/N. Figures 2; references 5.

UDC 621.396.677+621.396.67.029

Measuring Efficiency and Dissipation Coefficient of Millimetric-Wave Reflector Antennas by Radiothermic Method

907K0127D Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 32, No 11, Nov 89 (manuscript received, after revision, 22 Feb 88) pp 68-70

[Article by G. A. Andreyev, S. G. Agratin, and L. V. Zayentsev]

[Abstract] A method of measuring the efficiency and the dissipation coefficient of large and small millimetric-wave reflector antennas is described, this method being based on thermal radio emission of millimetric waves. Small antennas can be oriented in any direction and their performance parameters can be measured in the field with artificial calibrating bodies or in the laboratory with the aid of a collimating mirror, while large antennas such as those of radio telescopes are preferably oriented toward the upper hemisphere and their performance parameters can be measured best on the basis of radio emission by celestial bodies. The principle of this method rests on the proportionality between thermal radio emission intensity I recorded by a voltmeter and brightness temperature T of absorbing body (antenna) recorded by a thermometer. The efficiency is calculated as $\eta= (I_{A2}-I_{A0})/(I_p - I_{A0}$ and the dissipation coefficient is calculated as $\beta_m= 1 - (I_{A1} - I_{A0})/(I_{A2} - I_{A0})$ (A2 refers to measurement with the radiation source covering the antenna aperture, A0 refers to measurement with the radiation source away from the focal plane of the collimator, subscript "p" refers to measurement with the radiation source covering the aperture of the auxiliary antenna). Both efficiency and dissipation coefficient are referred to the major lobe of the antenna radiation pattern. Measurements by this method were made with a 30-cm Cassegrain antenna using a 60-cm parabolic collimating mirror and, as radiation source, a hot nichrome wire. In another experiment these two performance characteristics of the RT-22 radio telescope antenna at the Institute of Physics (USSR Academy of

Sciences) were measured by using radiation from Jupiter or preferably the Sun. Figures 3; references 3.

UDC 534:621.382

Acoustoelectrical Conversion in Semiconductor Devices

907K0127E Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 32, No 11, Nov 89 (manuscript received 13 Jul 88) pp 93-94

[Article by I. Ya. Kucherov, O. V. Lyashenko, and V. M. Perga]

[Abstract] An experimental study was made concerning deformation of semiconductor devices by ultrasonic waves and its effect on their performance, considering the period of deformation cycles to be much longer than the relaxation time for charge carriers. As specimens of such devices had been selected MPT37 field-effect transistors along with noninverting operational amplifiers on 538UN1 and K574UD1A microcircuit chips in metal-glass cases. Deformation of these devices was produced by ultrasonic waves arriving from a piezoelectric transducer made of ceramic with known amplitude-frequency characteristic, through a sound guide made of glass with an acoustic impedance matching that of a particular device. The amplitude and amplitude-frequency characteristics of the acoustoelectric effect in these devices were measured with alternating voltages of frequencies ranging from 0.05 to 1.5 MHz applied to the piezoelectric converter, an alternating voltage of an ultrasonic frequency being always recorded at the output of the semiconductor device. This voltage was much lower with the microcircuit chips in plastic cases and sometimes did not even exceed their intrinsic noise level. The frequency-dependent slope of the ultrasonic voltage conversion curve, which characterizes the sensitivity of a device to ultrasonic deformation and thus the conversion efficiency, was found to be determined by the static gain characterizing the electrical performance of a transistor or operational amplifier. The experimental data are analyzed and evaluated in the quasi-static approximation of ultrasonic deformation and the attendant deformation potential. Figures 1; references 3.

UDC 621.377.22

Wideband Surface-Acoustic-Wave Delay Lines

907K0127F Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 32, No 11, Nov 89 (manuscript received 3 May 88) pp 94-96

[Article by N. I. Burimov, L. Ya. Serebrennikov, and V. S. Shelukhin]

[Abstract] Considering that excitation of surface acoustic waves in delay lines at frequencies above 200 MHz is not readily achieved by means of conventional interdigital transducers, it was tried experimentally with wideband corner-type transducers having the two electrodes on adjacent orthogonal surfaces and step-type transducers having the two electrodes on adjacent levels of a stepped surface. Radio pulses of 1.75 V amplitude and 1-2 μs duration were applied to the electrodes of the radiator-transducer, the amplitude of output signals at the electrodes of the receiver-transducer being measured directly with an oscillograph and their phase being measured directly with a phase meter. The clearance between transducer and delay line was typically 10 μm. The performance of a delay line was greatly improved by electrodynamically matching both input and output transducers with the high-frequency channel, the losses decreasing by 4-5 dB at 120-260 MHz and by 5-7 dB at 400-700 MHz as a result. Figures 1; references 3.

UDC 621.371:551.526

Radiometric Method of Determining Temperature Profile in Subsurface Soil and Frozen Ground Depth

907K0128A Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 32, No 12, Dec 89 (manuscript received 4 May 88) pp 1467-1474

[Article by K. P. Gaykovich, A. N. Reznik, and R. V. Troitskiy, Scientific Research Institute of Radiophysics

[Abstract] A special method of radiometric sounding has been developed for remote measurement of temperatures in subsurface soil which eliminates the competitive effects of reflection by the surface and scattering by surface and volume inhomogeneities on thermal radio emission and brightness temperatures, methods of solving inverse problems being used for reconstruction of temperature profiles from the readings and determining the frozen ground depth under various conditions. Effects of both scattering and reflection are compensated by means of a metal shield. The theory of this method is demonstrated analytically on a deep ground layer equivalent to a randomly nonhomogeneous half-space with a dielectric permittivity consisting of a complex deterministic component uniform in space and a statistically uniform random component variable in space. The radiometer with a horn antenna is placed above ground and a metal shield is placed above parallel to the ground. The brightness temperature as a function of the absorption coefficient, when the latter is not a function of depth, can be evaluated by integrating the temperature as a function of depth from -infinity to 0. The inverse problem, an ill-conditioned one depending on the accuracy of measurements, is solved by numerical simulation for each form of kernel in that integral equation and each class of reconstructable profile. The method was tried in the February-March 1987 period for sounding a frozen ground with 3 cm, 9 cm, and 13 cm radio waves and the inverse problem was solved on the basis of the classical equation of steadystate heat conduction, assuming a constant surface temperature. The method was also tried in October 1986 for monitoring

the diurnal temperature dynamics of a soil (Karadag test station, Scientific Research Institute of Radiophysics, at Crimea's southeastern coast) with 0.8 cm, 3 cm, 9 cm, and 13 cm radio waves. In this case the inverse problem was solved by the Tikhonov method the Tichonov method on the basis of that integral equation. The authors thank D.M. Gordeyev for assistance in measurements in the Karadag test station and K.S. Stankevich for helpful comments. Figures 6; references 15.

UDC 621.371.029.65

Effect of Scattering on Radiation Brightness Temperature of Hydrometeors

907K0138B Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol32, No 12, Dec 89 (manuscript received 7 Jul 87, in final version 11 May 89) pp 1475-1484

[Article by V. A. Korotkov and Ye. V. Sukhonin, Institute of Radio Engineering and Electronics, USSR Academy of Sciences]

[Abstract] The equation of radiation transfer within a cluster of hydrometeors is solved analytically by an iteration method which takes into account the scattering of radiation. The cluster is assumed to form a homogeneous plane-parallel layer of a certain thickness and at a certain temperature T, this layer being bounded by the earth at temperature T_g with an approximately 1.0 surface emissivity from below and by the atmosphere at temperature T_a= 0 K from above. The equation of radiation transfer is split into two analogous integrodifferential ones for the intensity gradients of downward and upward radiation transfer respectively, each of them containing a term which represents interaction of the two radiation fluxes. Each intensity consists of a diffusion component, a function of the solid solid incidence angle and of the solid scattering angle. After each diffusion component has been integrated with respect to the solid incidence angle, the two equations are solved iteratively by for boundary conditions of zero intensity of downward and upward radiation transfer at the lower bondary and at the upper boundary respectively. An advantage of this solution is that its accuracy does not depend on the optical thickness of the hydrometeoric layer. The total attenuation coefficient as well as the scattering part of it are assumed to be the same for both directions of radiation transfer in the approximation of equal radiation transfer intensities. The scattering indicatrix and the radiation brightness temperature are then calculated on this basis, whereupon the results are compared with measurements of the radiation brightness temperature of rain. The temperature correction to account for radiation scattering is found to depend on the observation angle and on the scattering properties of the medium as well as on the thickness of the rain layer, radiation from the earth also contributing to the radiation brightness temperature of a rain layer unless the temperatures of both are equal. The proposed method of solving the equation of radiation transfer is simpler and not less accurate than known other methods such as the method based on fourflux theory and the method of small perturbations. The method is, moreover, suitable for measuring the attenuation of millimetric waves by rain and for estimating the radiation brightness temperature of dry snowfalls. Figures 6; tables 2; references 14.

UDC 621.371.332

Scattering by Finitely Long Ideally Conducting Cylinder with Absorbent Coating on Edges in Bistatic Configuration

907K0138D Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 32, No 12, Dec 89 (manuscript received 31 Mar 88) pp 1518-1524

[Article by O. I. Sukharevskiy and A. F. Dobrodnyak]

[Abstract] The problem of diffraction of a plane electromagnetic wave by an ideally conducting electrically long circular cylinder with one quadrant cut out and an absorptive coating on both sector surfaces is solved for the general bistatic configuration with arbitrary relative positions of radiation source, cylinder, and radiation detector. The method of solution combines the method applied to an earlier near-field problem of diffraction by an ideally conducting wedge with an absorbent cylinder along its cutting edge and asymptotic methods applicable to diffraction of short waves. Calculations are based on the Stratton-Chu integral representation of the scattered field at point x^0 outside the scatterer, this representation having been obtained with the aid of the Lorentz lemma. The resultant intensity of scattering by both sector surfaces is obtained in the approximation of physical optics. The effective scattering area is then evaluated numerically on the basis of a mathematical model describing a semifull-scale experiment. Figures 6; references 7.

UDC 621.391

Frequency Modulation of Carrier Wave with Radio Pulse Propagating through Dispersive Medium

907K0138E Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol32, No12, Dec 89 (manuscript received 10 May 88) pp 1558-1560

[Article by Yu. N. Zayko]

[Abstract] Distortion of a radio pulse carried by a wave and propagating through a dispersive medium is analyzed mathematically, a radio pulse becoming distorted owing to the frequency dependence of its group velocity. Upon introduction of the instantaneous frequency $\delta[dF]/\delta t + \omega_0$, where $\omega_0 + \Phi$ is the phase of the wave carried by the pulse, frequency modulation of this wave is considered in media with an arbitrary other than linear dispersion law and then in a Klein-Gordon

medium such as a regular waveguide with a cutoff frequency. Both amplitude A(z,t) and frequency Φ of the radio radio pulse are calculated, both being functions of the longitudinal coordinate z and time t. Oscillation of the radio pulse frequency can be utilized for recording the arrival of a radio pulse at some point z in a medium, the instant of arrival being the instant at which the instantaneous pulse frequency $\Phi(z,t)$ becomes equal to the carrier frequency ω_0 . Figures 1; references 3.

UDC 621.385.69

Effect of Electron Beam on Efficiency of Gyrotron and on Longitudinal Profile of its High-Frequency Field

907K0138F Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 32, No 12, Dec 89 (manuscript received 4 Apr 88) pp 1565-1567

[Article by G. S. Nusinovich and A. V. Pylin, Institute of Applied Physics, USSR Academy of Sciences]

[Abstract] The effect of an electron beam on the efficiency of a gyrotron and the structure of its high-frequency field is evaluated by a rather simple method, of interest being gyrotrons with cavity Q-factors approaching the minimum-diffraction level and with a high-frequency field whose longitudinal profile depends only weakly on the electron beam parameters. The function f which satisfies the gyrotron equation $d^2f/d\sigma^2 + \gamma^2 f = I$ for a not yet fixed high-frequency cavity field is expressed as a sum $f = Ff_0 + f_1$ of the field profile where f_0 with an amplitude F in a "cold" cavity and an increment or decrement f_1 much smaller than Ff_0. In that equation I is the gyrotron current proportional to the electron beam current, p is the transverse momentum of electrons determined from the equation of motion for electrons, and γ is the referred wave number. The gyrotron equation is solved by the method of successive approximations, whereupon the gyrotron characteristics including the dependence of its starting current on the frequency deviation are calculated for given values of the gyrotron design parameters. Figures 3; references 5.

UDC 537.876.23:523.42

Attenuation of Radio Waves and Sulfuric Acid Vapor Content in Venus' Atmosphere

907K0097C Moscow RADIOTEKHNIK I ELEKTRONIKA in Russian Vol 34, No 11, Nov 89 (manuscript received 1 Jul 88) pp 2278-2285

[Article by V. N. Gubenko, O. I. Yakovlev, S. S. Matyugov, A.I. Kucheryavenkov, and I.R. Vaganov]

[Abstract] Some of the data obtained by sounding Venus' atmosphere with centimetric and decimetric radio waves from "Venera-15,16", "Pioneer-Venus", and "Mariner-5,10" space probes are utilized for analysis of the atmospheric middle layer (47-80 km altitudes) above polar and circumpolar regions of Venus' northern hemisphere, that layer having been sounded with 5 cm and 32 cm radio waves in the transmission mode from the probe "behind" Venus to Earth during a "Venera-15,16 experiment as well as with 13 cm radio waves during a "Pioneer-Venus" experiment and with 3.6 cm radio waves during a "Mariner-10" experiment. The data are analyzed for absorption of 5 cm radio waves and information they carry about the H_2SO_4 vapor content in that atmospheric layer. The attenuation coefficient and its altitude dependence are calculated according to applicable theoretical and semiempirical relations, considering that "Pioneer-Venus" and "Mariner-10" data cover other regions of Venus' atmosphere and that 10 years separate "Venera-15,16" flights from "Mariner-10" flight. Figures 4; references 15.

UDC 621.391.1

Estimation of Signal Frequency on Basis of Frequency Sampling

907K0128C Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (manuscript received 6 Mar 89) pp 23-26

[Article by V. V. Blatov]

[Abstract] The optimum algorithm of estimating the frequency of a sinusoidal signal in an additive mixture with a Gaussian noise is analyzed, the optimum frequency meter being a multichannel instrument which processes sampled frequency data with a computing device at the common output of all usually narrow-band optimum frequency-to-code converter channels. Estimates made by such a frequency meter are efficient according to the Rao-Kramer criterion. The efficiency of estimates made by a frequency meter having as frequency-to-code converter a digital frequency detector with m= 256 channels 11.2 Hz wide each (median frequency 215 kHz) is calculated on the basis of 100 measurements with a 132 μs sampling period and found to be efficient when the signal-to-noise ratio V_m/σ is higher than 3 (V_m - amplitude of signal, σ - dispersion of noise). Tables 2; references 7.

UDC 621.372.853.1:537.874.6

Diffraction of Surface Waves by Two Metal Cylinders

907K0097A Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 11, Nov 89 (manuscript received 26 Apr 88) pp 2245-2250

[Article by V. I. Kalinichev and N. M. Solovyev]

[Abstract] The problem of diffraction is formulated and solved for surface waves and two identical metal cylinders equidistant from a dielectric plate between them which serves as a waveguide with the axis parallel to theirs. The problem is analyzed and calculations are made for a waveguide E_1-mode incident normally to their axes. The field between the plate and each cylinder is treated as that of multiply reflected plane waves forming a continuous space spectrum. Equivalence between this symmetric structure and an asymmetric one with an electric wall having been established, the field inside the plate is treated as that of plane waves both scattered and reflected into the latter by metal sheaths. The conditions of a self-consistent field yields an integral equation of the second kind for the spectral function. Determination this function reduces to determination of coefficients which are Fourier transforms of surface current density on the cylinders and which satisfy an infinite system of linear algebraic equations. The latter is, after truncation, readily solved numerically by the Gauss method. Diffraction of an H_1-mode wave is treated analogously. Elements of the scattering matrix as well as reflection and transmission coefficients, also the radiation (power) pattern, have been calculated for both polarizations with the dielectric plate ($\mu\varepsilon$= 10) touching both metal cylinders. Figures 5; references 6.

UDC 537.874.35(253)

Attenuation of Microwave Radiation Passing through Vegetation

907K0097B Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 11, Nov 89 (manuscript received 14 Mar 88) pp 2269-2278

[Article by A. A. Chukhlantsev and S. P. Golovachev]

[Abstract] A method of measuring the integral attenuation coefficient for microwave radiation passing through a layer of vegetation and of determining its dependence on the moisture reserve $W = \rho m_V h$ (ρ - density of vegetation, m_V - water volume in the plants, h - height of the plants) or the biomass Q of vegetation was applied to several crops: lucerne, pea, clover, wheat, rye, cereal grass, and camomile. Two series of measure ments were made, as required in this method. First measurements were made with tunable radiometers covering the 1-6 GHz frequency range (1-30 cm wavelengths) with a 60 MHz passband and a 1-1.5 K temperature fluctuation sensitivity, a layer of fresh cut plants heaped once on a metal tray with a near unity re flection coefficient and

once on an sheet of absorbing material with a near zero reflection coefficient in the far field of the radiometer antenna. Then, for determining the dependence of the attenuation coefficient on the vegeta tion density, measurements were made with a 2.25 cm wavelength radiometer. Its antenna was inserted into a bin from below through a hole in the bottom, the bin bottom and walls all made of a radiation absorbing material and its open wide top facing the zenith. Cut plants were packed into a metal cylinder and the latter cradled across the top of the bin, the bin being sufficiently tall to put the cylinder with vegetation in the far field of the radiometer antenna below. Both reflection and transmission coefficients were calculated from readings of the brightness temperatures of vegetation, air, and background objects. The results of these measurements are correlated with and evaluated on the basis of a theoretical model, namely a discrete distribution of leaves and stems whose absorption and transmission of the "mean radiation field" is described by the dispersion equation for the wave number. The results reveal that the dependence of the integral attenuation coefficient on the moisture reserve is linear only when the vegetation density and the water content in the plants remain constant, this dependence becoming nonlinear when either or both these parameters vary. Attenuation of centimetric-wave radiation was found to be a multiparameter depending also on the ratio of imaginary part to real part of the dielectric permittivity of the crop and especially on the size (height) distribution of the plants. Figures 5; references 27.

UDC 621.396.96

Recognition of Objects from Readings of Short-Pulse Radar

907K0097D Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 11, Nov 89 (manuscript received 2 Mar 87) pp 2304-2311

[Article by A. S. Kuznetsov and B. A. Stryukov]

[Abstract] An experimental study with a short-pulse radar was made, to determine the feasibility of its use for automatic recognition of conducting objects and thus its capability of recognizing radar-related indicators of such objects. The apparatus included a 100 W traveling-wave tube excited at its microwave input by a voltage drop of subnanosecond duration and generating pulses of 0.5 ns duration at a repetition rate of 0.1 MHz, the average signal wavelength of signals being 8 cm. The two P6-23 broadband transmitter and receiver antennas were placed with their apertures in the same plane and their centers 30 cm apart. Target objects were mounted on foam-plastic support 4 m away from the transmitter antenna so as to put an object not larger than 0.5 m in the far field. As the primary indicator of an object served its effective scattering area rather than its frequency characteristic, the latter depending on the distance from the antenna and thus varying during random motion of the object. Statistical analysis of the data yields a high probability of correct recognition of objects whose dimensions are comparable with the average signal wavelength, the echo signal carrying extractable groups of indicators invariant relative to orientation of the object. Figures 5; references 6.

UDC 621.396.677.01

Resolution of Coherent Signals by Plane Antenna Array

907K0097E Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 11, Nov 89 (manuscript received 1 Feb 88) pp 2311-2316

[Article by V. S. Gitelson and I.V. Petrova]

[Abstract] A plane antenna array consisting of equidistant linear subarrays is considered for unambiguous resolution of coherent or partly coherent signals. The two-coordinate problem is formulated as an inverse one: from the spectral correlation matrix $K(m,n)= B(m,n) + \sigma^2 I_N$ of antenna output signals determine the number M of plane-wave input signals additively mixed with noise I_N in the receiver channels and their directions of arrival, if their number M is smaller than the number N of antenna array elements but equal to or higher than the rank of matrix B(m,n). The algorithm of the solution involves generating linear envelopes from vector-columns of the partitioned B(m,n) matrix. The number of input signals can then be determined and polynomial functionals be constructed for calculation of angles which define the directions of their arrival. Figures 2; references 4.

UDC 621.396.96.01

Errors in Estimating Motion Parameters of Maneuvering Objects

907K0097F Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 11, Nov 89 (manuscript received 11 Apr 88) pp 2316-2322

[Article by V. I. Shiryayev and L. V. Parskaya]

[Abstract] Estimation of parameters which characterize the motion of maneuvering objects is analyzed for errors due to discrepancy between the real model of motion and the model which has served as basis for filter synthesis, the real model including additively mixed random and nonrandom indeterminacies. An object of the i-th type is considered whose motion is described by the real equations $\bar{x}(k+1)= A_i\bar{x}(k) + B_i\,\bar{u}(k)$ ($k= 0,1,2,...$). Here $\bar{x}(k)$ is the vector of phase coordinates, $\bar{u}$ is the control vector, A_i and B_i are constant matrices of appropriate dimensionality. The object is tracked for estimation of it motion on the basis of a somewhat different model $\bar{x}'(k+1)= A'\bar{x}'(k) + B'\bar{w}'(k)$ and an equation of measurements $\bar{y}(k) + \bar{\xi}'(k)$, where $\bar{w}'(k)$ and $\bar{\xi}'(k)$ are mutually independent Gaussian vectors with zero mean values and given covariance matrices. A source of estimation errors is also the unaccounted for nonrandom component of noise $\bar{\xi}'(k)$

existing along with its accounted for random component $\xi^{-}(k)$. Following an accuracy analysis of a synthesized Kalman filter, including the asymptotic behavior of filtration errors, the solution of control problems under conditions of maximum nonrandom noise component is outline for objects of any type i in the [begin set] $1,\gamma$ [end set] set. It is then demonstrated on an example where the equations of motion according to both models and the equation of measurements can be split into two independent but identical systems of equations for distance and azimuth respectively. Tables 1; references 24.

UDC 621.395.387.001.4

Universal Correction Method for Sampled-Data Systems

907K0111A Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 89 (manuscript received 5 Sep 88) pp 8-10

[Article by A. N. Polyakov, candidate of technical sciences, 'Elektrostal' (Electrical Steel) Works

[Abstract] A method of correcting sampled-data systems is proposed which will ensure stability as well as the required regulation characteristics and compensation of the input error signal. It is based on the theory of automatic control and is analogous to neutralizing the effect of pure delays in stabilization systems. It is demonstrated on a pulse-amplitude-modulator, a simple system consisting of an ideal pulse generator (switch) and a zeroth-order pulse shaper-extrapolator. Correction of such a system according to this method involves making its closed-loop transfer function match the transfer function of the original open-loop system plus an analog regulator behind it. The inserted correcting device must have a transfer function which will make the resultant transfer function of the thus corrected closed-loop system identical to that of the original open-loop system with a regulator. The design of the correcting device will depend on the specific application, an additional transformation but no structural modification being necessary when regulation errors are to be measured at discrete instants of time only rather than continuously. The correction method is thus a universal one and essentially an extension of correction methods for continuous-time signal systems. Figures 6; references 4.

UDC 621.313.333.3.088.6/7.001.4

Digital Control System for Asynchronous Electric Transistor-Motor Drive

907K0111B Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 89 (manuscript received 9 Feb 89) pp 11-15

[Article by R. P. Gerasimyak, doctor of technical sciences, and V. V. Busher, Odessa Polytechnic Institute]

[Abstract] A digital speed control system ensuring high static and dynamic stability is synthesized for an asynchronous electric drive, an induction motor powered through a thyristor bank acting as voltage inverter. The thyristor-motor set is controlled by speed feedback through a tachometer followed by an analog-to-digital converter as time-discretizing output switch and a digital voltage control system. The latter includes a programmed reference-speed voltage generator behind a time-discretizing input switch and a speed regulator which receives the difference between tachometer output voltage and reference-generator voltage. This difference is converted into to a firing-angle signal which, through another time-discretizing switch and a zeroth-order clamp circuit, passes on to a pulse-phase-modulation system for control of the thyristor firing angle. An open-loop and closed-loop analysis of this system indicates that a proportional-integral speed regulator will ensure higher static stability than a plain proportional one. The algorithm of regulation during the transient periods can be optimized so as to combine high response speed and minimum possible overregulation. Such a system has been built and tested and then successfully tested on an MTN-111-6 motor in an experimental laboratory. Programs have been written for incorporation of a KR580VM80A microprocessor in the control system. Figures 3; references 4.

UDC 621.313.322-81.045.3:537.312.62

Dependence of Magnetic Field Intensity in Superconductor of Cryoturbogenerator on Geometry of Field Winding

907K0111C Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 89 (manuscript received 16 Feb 89) pp 16-19

[Article by V. I. Leonov, engineer, Scientific Research Institute 'Elektrosila' (Electric Power) at Leningrad Economic Planning Department]

[Abstract] A design analysis of cryoturbogenerators with superconductor field winding reveals how the magnetic field distribution in the superconductor depends on the geometry of such a field winding. Numerical calculations were made for a field winding consisting of five parallel flat coils symmetrically disposed inside a cylindrical stator. The sum of their cross-sectional areas and the total number of turns were held constant, also the fundamental component (first harmonic) of the magnetic flux. Variable were the distance between the coils and thus the ratios of their cross-sectional areas (the center coil remaining in place and its cross-sectional area set equal to 1), determined by the lengths and the rounding radii of their extensions beyond the stator shell. In order to determine the dependence of the maximum magnetic induction at the mean winding radius on these variables, it was necessary to appropriately adjust the field current. Inasmuch as the field current in a superconductor is in reality not freely adjustable, being limited by the critical parameters of the superconductor material, the design analysis has been supplemented with an evaluation of the current margin and its dependence on those variables. Figures 4; tables 1; references 8.

UDC 621.396.96:621.391.26

Fast Scan of Compound Signals with Multiply Peaked Autocorrelation Function

907K0128A Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (manuscript received, after completion, 3 Feb 89) pp 7-10

[Article by V. P. Yefimov, V. M. Tamarkin, and L.G. Taranenko]

[Abstract] Compound nonlinear sequences are considered for data transmission in wideband systems, the period of such sequences being period $L= 2^n - 1= (2^k - 1)s$ where n,k,s are positive integers. Their normalized periodic autocorrelation function has sharp lateral peaks $R(\tau)= -1/L$ at any length of the delay time τ besides the points at successive intervals $s\tau_0$from the main peak (τ_0 - length of symbol in a compound nonlinear sequence). Such sequences are shown to ensure not only a higher interference immunity but also a faster scan for delay within the indeterminacy zone than conventional stepwise single-channel scan of compound signals which have a single-peak autocorrelation functions. This is demonstrated analytically for the case of high signal-to-interference ratio, only then a general expression being obtainable for the probability of a successfully completing the scan within a given time, and on the assumption of an interference normally distributed with uniform spectral density. The mixture of signal and interference is processed in a correlational detector, the correlator output voltage being compared both lower and upper thresholds. When neither is exceeded, then the delay of the reference signal is changed by one scan step. When only the lower threshold is exceeded, then the delay of the reference signal is changed successively by $i\tau_0$ (i= 1,2,...,l-1). When also the upper threshold is exceeded, then the delay of the reference signal is not further changed and the received signal is locked into a delay tracking system. The statistical characteristics of the scan time and then the detection characteristics, namely probabilities of detecting the main peak of the autocorrelation function, of not exceeding the upper threshold after the lower one has been correctly exceeded, and of exceeding it when the delay time of the reference signal has been changed, are calculated on the assumption that delay scan precedes frequency scan and lock. It is also assumed that exceeding the upper threshold results only in additional loss of time. Although lateral peaks of the autocorrelation function generally give rise to statistical dependence of the correlator outputs, with peaks smaller than 0.3 this dependence can be disregarded. Figures 4; references 7.

UDC 621.396.62

Probability of Intermodulation Interference Falling within Signal Frequency Band

907K0128B Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (annotation of article No 1511-sv deposited at Central Scientific and Technical Institute 'Informsvyaz') pp 13-15

[Article by A. M. Bobkov]

[Abstract] A problem concerning of electromagnetic compatibility of radio engineering systems is solved analytically, this problem being to calculate the probability of at least one intermodulation interference signal among a wideband set of N random and mutually independent such signals falling within the much narrower frequency band of the useful signal with a given center frequency. Expressions are derived for this probability which cover all 50 types of up to 5-th order intermodulation interference, calculations being made for interference uniformly distributed over its frequency band. In this case that probability is a power function of the interference frequency with an exponent generally equal to the interference order minus 1. The assumption of mutually independent intermodulation interference signals leads to an overestimation error which does not exceed 10% for up to 3-rd order interference.

UDC 621.391.144

Method of Calculating Cross-Correlation Functions for Multiphase Signals with Various Bases

907K0128D Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (manuscript received, after completion, 21 Feb 89) pp 44-45

[Article by V. V. Zhitkov]

[Abstract] Expressions describing the cross-correlation functions of multiphase pseudonoise signals with various keying bases are derived, such a signal of length T with base p generally comprising a sequence of elementary radio pulses of duration τ_0 and with initial phase $2\pi x_k /p$ each. The sequence corresponds to a code sequence or vector $x= (x_0,...,x_k,...,x_{N-1})$Here x_k are members of set P(0,1,...,p-1), p is the keying base, and $N= T/\tau_0$ is the signal base. One expression applies to a matched filter which is tuned to a signal with keying base p but receives a signal with a different keying base q, in which case recoding becomes necessary. This expression is transformed so as to apply to the modulus of cross-correlation function. Another expression applies specifically to the periodic cross-correlation function of multiphase Frank signal (p= 3) and a binary phase-shift-keyed signal (q= 2). In the special case of p= q it is most expedient to substitute p for pq and proceed without recoding. References 2.

UDC 621.376.9

Multioperator Demodulation of Discrete Signals

907K0128E Moscow RADIOTEKHNIKA in Russian No 12, Nov 89 (manuscript received, after completion, 14 Feb 89) pp 46-47

[Article by N. P. Khvorostenko]

[Abstract] Two algorithms of parallel multioperator demodulation are comparatively evaluated for suitability in communication channels, the algorithm of self-selection yielding optimum a posteriori estimates of reception quality under all possible conditions and the algorithm of weighted summation ensuring a higher interference immunity in a channel not statistically matched with any of the operators. Demodulators with two or three operators in parallel are recommended for communication channels with likely appearance of additive interference signals lumped in time or space, or spectrally, the self-selection algorithm then being preferred. References 3.

UDC 62.373:621.373.521

Radio Signal Processing by Self-Excited Oscillators with Additional Feedback

907K0128F Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (manuscript received, after completion, 13 Jul 88) pp 48-51

[Article by G. G. Kile and S. M. Smolskiy]

[Abstract] When synchronized self-excited oscillators are used for separating message signals from strong interference in subgigahertz communication channels, their performance can be improved by adding a high-frequency feedback to the existing one. For digital data transmission systems is considered an oscillator on a transistor pair between two amplifier stages. The single-transistor stage which precedes the oscillator amplifies the synchronizing input signal. The single-transistor stage which follows the oscillator and includes feedback through a capacitor amplifies the output voltage signal. The performance of such a device is analyzed for stability of oscillations and speed of response to frequency jumps as well for interference immunity. The analysis is based on the simplified equivalent circuit of two current sources in parallel feeding an admittance load shunted by their internal admittance and on the corresponding abridged symbolic complex differential equation of Kirchhoff's first law. This equation reduces to a system of two, the nonlinear symbolic internal admittance having been resolved into its resistive and reactive components. The benefit of this additional feedback is revealed by open-loop and closed-loop calculations. Large phase shifts readily attainable in this feedback loop, while only slightly lowering the amplitude of synchronous oscillation, make it feasible to substantially widen the synchronization band and raise the speed of response to a frequency-shift-keyed input signal. Figures 4; references 6.

UDC 621.391.81

Statistical Model of Multipath Propagation of VHF Waves through City

907K0128G Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (manuscript received, after completion, 13 Feb 89) pp 56-61

[Article by L. Ye. Varakin]

[Abstract] A statistical model is constructed to describe multipath propagation of VHF waves through a city, taking essentially into account their reflection by individual objects and foremost by the ground surface. The known relation for the electric field reflected by the ground surface is shown to be applicable to any other reflector with an overall surface area or linear dimensions larger than those of its actually reflecting region. Reflection by a solitary building is described on this basis, the reflected wave beam then combining at the receiver with the wave beam which arrives from the transmitter directly. Inasmuch as reflectors located within one reflection ellipse produce a single beam, if the incidence angle and thereflection angle are equal, a real reflector is considered assuming that the width of its radiation pattern is approximately inversely proportional to its linear dimension. An expressions is derived for the probability of its optimum orientation relative to both transmitter and receiver, whereupon an expression is derived for the reflected beam reaching the receiver. Next is considered noncoherent superposition of signals arriving from reflectors within the same ellipse with generally arbitrary initial phases, the probability of their coherent superposition being extremely low. In this case there takes place an addition of powers and the resultant signal is a normal random one with a Rayleigh envelope. Calculations are made for a reflection ellipse as wide as the urban subdivision site, the site assumed to be square. The possible number of reflectors within such an ellipse is $m = 2rE(r_0 r)/D$, where $E(r_0/r$ is a complete elliptic integral (r_0 -distance between receiver and transmitter, r - distance traveled by wave beam from transmitter to reflector and then to receiver, 2a - major axis of reflection ellipse approximately equal to r, D - length of side of square building site). The average power of a multibeam signal is calculated on this basis and the power of the first beam is calculated on the basis of Ye.L. Vvedenskiy's law. Figures 6; references 14.

UDC 621.391.8:621.39.08

Effect of Intersymbol Interference on Interference Immunity of Discrete Data Transmission over Fiber-Optic Communication Line

907K0128H Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (manuscript received 18 Dec 88) pp 72-74

[Article by N. A. Litsarev and A. A. Filitsi]

[Abstract] Discrete data transmission over a fiber-optic communication line to a receiver with a differential amplifier behind the avalanche photodiode and followed by a two-threshold comparator is analyzed for the effect of intersymbol interference on the error probability, the comparator output signals being synchronized in a sampler of clock pulses. The modulator, on the transmitter side, includes a light-emitting diode or a semiconductor laser and a pump. In the case of ideal synchronization on the receiver side an error will occur when noise overshoots one of the bilateral thresholds within the time period from the instant a symbol appears to the instant a reading is taken. The normalized correlation coefficient for the amplifier output signal is calculated according to the Wiener-Khintchin theorem, with two RC-circuits having identical time constants equal to that of the input stage substituted for the modulator and the fiber-optic line respectively. The error probability is then calculated for various ratios of two time constants on the receiver side: that of the input stage to that of the differential amplifier. Figures 3; references 3.

UDC 535:621.385

Autodyne Polarization Reflectometer

907K0128I Moscow RADIOTEKHNIKA in Russian No 12, Dec 89] (manuscript received,after completion, 24 Feb 89) pp 74-78

[Article by V. N. Listvin, S. V. Shatalin, and R. V. Yushkaytis]

[Abstract] An autodyne reflectometer is described which receives laser radiation backscattered in a single-mode optical fiber, an He-Ne laser being used as light source optically coupled to the fiber. The latter, with respect to Rayleigh backscattering, is an optical transmission line with distributed parameters. The characteristics of a laser operating in the autodyne mode under these conditions are calculated on the basis of equations for its emission intensity and frequency in the quasi-steady approximation, taking into account delays and polarization effects in the optical fiber. The backscattering matrix, equal to the integral the triple product of the Jones matrix by its transpose and the forward-wave-to-backward-wave coupling coefficient, is evaluated for linearly frequency-modulated radiation with a 1 GHz frequency deviation and for isotropic Rayleigh backscattering with a correspondingly scalar coupling coefficient. An experiment was performed with a 0.63 μm single-frequency single-mode He-Ne laser, its frequency being modulated to a 600 MHz deviation by moving one cavity mirrors on a piezoceramic base according to a ramp law and its radiation focused by a lens onto the entrance to the fiber. The radiation exiting from the fiber was detected by a photodiode and from there sent to a low-frequency spectrum analyzer. Figures 4; references 16.

UDC 621.317

Statistical Error of Spectrum Estimate by Analyzer with Optical Fourier Processor and Integration over Time

907K0128J Moscow RADIOTEKHNIKA in Russian No 12, Dec 89 (manuscript received, after completion, 6 Mar 89) pp 78-81

[Article by B. I. Meltreger and V. I. Yakovlev]

[Abstract] Use of optical Fourier processors with integration over time is considered for analyzing the spectrum of random electric signals, such a processor comprising an array of photosensitive charge-coupled devices and the kernel of the Fourier transform being generated by intensity modulation of the light. The statistical error of estimates made by this method is defined in terms of the dispersion. Complete calculation of the periodograms requires squaring both real and imaginary parts of the Fourier transform, the two squares then being added, but in this case both parts contribute equally to the error and thus only the real part needs to be evaluated. Assuming for specificity an input signal in the form of a quasi-white noise and a modulator characteristic which is linear over the period of input signal change from 0 to maximum, also a flashing characteristic of photosensitive charge-coupled devices which is linear over the period of energy level change from 0 to maximum, the error calculated on this basis reveals its dependence on the intrinsic noise in these devices. The error may remain within acceptable limits, but the input signal power must not vary by more than 20 dB. Figures 2; references 4.

UDC 629.013

Dynamic Characteristics of Roll Control for Aircraft Model Electromagnetically Suspended in Wind Tunnel

907K0130A Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32, No 12, Dec 89 (manuscript received 12 Apr 89) pp 21-24

[Article by V. P. Bulekov and V. S. Volkov, Moscow Institute of Aviation imeni S. Ordzonikidze]

[Abstract] An electromagnetic suspension for aircraft models in wind tunnels is considered which allows controlling the roll of such a body independently of its movements about other axes. This is achieved by means

of four pairs of magnets forming an orthogonal configuration of four magnets around each end of the model, each pair mounted on a common C-yoke parallel to the model but at a 45° angle to the coordinate planes so that the planes in which the electric fields propagate do not intersect the longitudinal axis of the model. Analysis of the dynamic characteristics of this device is based on Newton's second law of motion, the torque produced by the magnets to change the roll angle being calculated on the assumption that most of the magnetic energy is concentrated in the air gap and that no fringing of the magnetic flux occurs. These assumptions make the magnetic induction linearly dependent on the magnetic field intensity and the latter linearly dependent on the current in the magnet windings. Two equations are formulated to describe the mechanical action on the model and the electrical process in the magnet windings, assuming, assuming that the rolling motion depends neither on the pitch and yaw angles nor on linear displacements. In an experiment this device was tested in the relay-type control mode with application of a constant voltage of a polarity depending on the direction of roll, the roll angle being measured with a string and an optoelectronic transducer. An analysis of its performance in this mode indicates that taking into account the inductance of the magnet coils does not alter the qualitative pattern of both mechanical and electrical transients. Figures 2; references 3.

UDC 519.2

Analysis of Distributed Computer Systems Operating in Real Time

907K0130C Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32, No 12, Dec 89 (manuscript received 30 Jan 89) pp 29-34

[Article by A. I. Gerasimov, Moscow Textile Institute]

[Abstract] Real-time operation of distributed digital computer systems is analyzed, considering that their software does not change in time so that the computation process is organized in an essentially sequential cyclic mode. The analysis of such systems and their organization is based on the model of a closed cyclic queuing network such as the Integrated Services Digital Network with one circulating message. The design of such systems, based on the number of transmitting subsystems and the number of receiving subsystems, involves essentially determination of the number of processors necessary for solution of all problems within the given scope as the load varies. The ranges of time delays are established, taking into account the diversity of processing cycle frequencies. The error of computation in real time is estimated, its main three components being: 1) error due to discreteness of data pickup and an upper limit on the cycle frequency ceiling, 2) error in the computation algorithms, one of them due to an upper limit on the word length, 3) error in the input data due to obsolescence. Following a design analysis for the specific case of data exchange between five data suppliers and five data users, an algorithm of loading the computer system channels is constructed on the basis of a known time required for transmitting n words over an external interface: typically 40 + n.20 μs. Figures 3; tables 3; references 8.

UDC 681.322.012

Estimating Productivity of Output Channel for Design of Raster-Graphic Video Terminals

907K0130D Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32, No 12, Dec 89 (manuscript received 21 Apr 89) pp 39-44

[Article by T. T. Paltashev, I. B. Smirnov, and E.V. Starodubtsev, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Design of raster-graphic video terminals for applications ranging from automated industrial control and scientific research to personal computers is analyzed on the basis of a performance analysis of the data output channel, the latter being treated as a multilevel software and hardware structure subject to technical and cost constraints as well as service requirements of which productivity is a major one. As a sufficiently general model for this analysis, which includes estimation of the channel productivity, is selected an XY graphic terminal. It consists of output channel controls, a graphic data processor, a raster image generator, an input interface, a video memory in the form of a three-dimensional LSI matrix following the input interface, and an output interface which consists of a display processor with a video control unit between the video memory and the video monitor. The output channel controls, the raster image generator, the geometrical processor, and the display unit are interconnected by a system interface as well as by data transmission trunks. The performance of such an output channel is evaluated in terms of productivity, the critical parameter being its upper limit, and the time loss in interaction between the video memory and the output face are evaluated on the basis of structural and functional analysis including analysis of code formation. The evaluation includes the dynamic characteristics of such an output channel, also determined by both the hardware for a specific application and the software for execution of the necessary algorithms. Figures 1; references 3.

UDC 551

PHOBOS-Project Laser Rangefinder

907K0130F Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32, No 12, Dec 89 (manuscript received 10 Jan 89) pp 68-71

[Article by A. M. Vladykin, V. D. Glazkov, M. I. Kalinin, and Ye. G. Lebedko, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] A rangefinder has been developed for the international "Phobos" (Mars satellite) exploration project capable of measuring 20-80 m altitudes above the Phobos surface at least 50 times per second with means of displaying the results in digital as well as analog form. The criteria of minimum size, weight, and energy consumption were most satisfactorily met by a pulsed rangefinder with a semiconductor laser as radiation source. In order to design and construct this instrument, it became necessary to solve three major problems. The first problem was timing pulses of 100 ns duration accurately within 1 ns over the 0.1-0.4 V range of amplifier output signals on the receiver side during temperature drops of up to 70°C. This problem was solved by differentiating the input signal and clamping its derivative at the zero computing level, which not only eliminated all dynamic errors of signal positioning but also greatly improved the interference immunity of altitude readings. The second problem was ensuring an adequate output signal power while the power of input radiation pulses may vary over an even wider than 200:1 range, without automatic regulation in the receiver so as avoid additional phase distortions. This problem was solved by stabilizing the input radiation signals during changes of altitude with the aid of spatial selection, namely appropriately selecting of the forms of radiation and reception fields as well as their overlap at various altitudes. The third problem was including both reliable and high-speed time interval measurement. This problem was solved by indirect time-to-code conversion involving a preliminary transformation of the original time interval into a measurable longer one and by thus trading off accuracy of proportional direct time measurement for optimum frequency of the quartz oscillator. The laser rangefinder consists essentially of two modules. The first one contains the transmitter and the receiver, the optical system on the input side, and the pulse forming "start"-"stop" trigger on the output side. The the second one, driven by the "start"-"stop" trigger, contains the time interval meter, a quartz oscillator, a calibrator, a reference-voltage generator, a digital-to-analog converter, and a control device. The second module can operate in either the "measure" mode or the "test" mode so as to facilitate control of both the reflector and the focuser of high-intensity laser radiation, definite time intervals being set from the instant of radiation emission to the instant of radiation reception to the the display of altitude readings in both digital and analog form. The instrument has been structurally designed for placement on board of a spacecraft with primary and secondary power supplies. Figures 1; references 5.

UDC 535.8

Determination of Deformation Level of Large Mirrors

907K0135A Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32, No 11, Nov 89 (manuscript received 26 Apr 89) pp 54-60

[Article by G. V. Kirchin, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Design optimization of large mirrors with respect to minimum weight is considered, which requires estimating the deformation of such a mirror under the weight of its component parts and the attendant displacement of key points on its surface. An approximate method of estimating is demonstrated on a spherical metal-glass mirror with a 700 mm radius of curvature, its outside and inside diameters being 150 mm and 60 mm respectively. The reflecting surface is coupled to a support belt through a cylindrical transition piece and the entire structure is fastened to a horizontal base by eight bolts. Owing to symmetry, only one octant needs to be considered. With the optical axis oriented vertically, the gravitational field induces in the mirror a plane state of stress so that the deformation of one sector does notdepend on the other sectors and parts. A mirror octant is treated as a continuous beam under an array of concentrated vertical bending forces. Its compliance matrix D is an mXm-dimensional square one for m degrees of kinematic freedom and equal to the product D= M(supTD_0M, M being the matrix of bending moments, D_0 being the 2nX2n-dimensional diagonal partitioned compliance matrix of n constituent beam segments as free bodies, and M^T being the transposed matrix of bending moments. Displacement of the k-th node is calculated as the sum of j from 1 to m products of i from 1 to n sums $M^T_{ik}d_iM_{ij}$ by P_j loading forces, the being altogether m such forces on the beam. The beam cross-sections are assumed to be rectangular, with a moment of inertia $I_i= b_iy_i^3/12$ accordingly. Numerical calculations are made for a mirror made of a titanium alloy (density 4.4 g/cm$^{3)}$and a V= 15.6 cm^3 volume per octant consisting of five beam segments. Figures 3; tables 2; references 6.

UDC 629.7.054.5

Accuracy Analysis of Optoelectronic Devices with Multielement Photodetectors

907K0135B Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32, No 11, Nov 89 (manuscript received 5 Apr 89) pp 64-68

[Article by V. L. Bokov, Yu. V. Novikova, V. S. Pashkov, and N. A. Tideman, State Institute of Optics imeni S.I. Vavilov]

[Abstract] Optoelctronic instruments with multielement charge-transfer photodetectors and with objectives forming non-Gaussian illuminance distributions over the image of a point are analyzed for systematic error, taking into account the effect of various factors on the accuracy of such a device. The three factors under consideration here are gaps between the photodetector matrix elements, dimensions of a matrix resolution element, and the aperture characteristic of a matrix element. Errors arising in measurement of the coordinates of points on the axis and on the edges of an image are estimated, of concern being their dependence on those three factors alone and in the presence of noise. The coordinates of image points in the charge-transfer plane are for this purpose estimated by two methods: weighting and least squares with use of a truncated

Fourier series for a 4x4 matrix element. The r.m.s. error has been calculated by computer simulation for two mirror-lens objectives with identical fields of view, aperture ratios, and spectral ranges, one producing a nearly Gaussian illuminance distribution over the image of a point source and one producing an annulus with a nearly triangular illuminance distribution as image of a point source. The systematic error estimated by either method is found to be smallest for a 3:1 or so ratio of image diameter to matrix element dimension, more sensitive to changes in the gaps between matrix elements being the error estimated by least squares and more sensitive to changes in the aperture ratio being the error estimated by weighting. Figures 3; references 7.

UDC 621.375

Analysis of Signal Spectrum for Determination of Bandwidth of Diffraction Instrument Transducer

907K0135C Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROROSTROYENIYE in Russian Vol 32, No 11, Nov 89 (manuscript received 17 Feb 89) pp 69-73

[Article by A. S. Mitrofanov and G. D. Fefilov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] The bandwidth of the conversion channel in a diffraction instrument transducer is calculated on the basis of the signal spectrum, the time interval between the appearance of successive signal extrema during scanning of the Fraunhofer diffraction pattern being the measured quantity and the maximum allowable variation of its length being selected as the constraint which limits that bandwidth. The length of that time interval is equal to the width of a diffraction peak divided by the scanning speed, the width of a diffraction peak being equal to the product of radiation wavelength and focal length of the objective divided by the dimension of the inspection piece. As mathematical model of a signal is selected the Airy function describing the amplitude distribution in the Fraunhofer pattern around a circular hole. Two signals are selected for analysis, one describing the intensity distribution over lateral diffraction peaks and one forming as the intensity maxima become equalized or as the amplitude of the variable intensity component is varied in time by an electric signal. Their spectra are analyzed on the basis of Parceval's theorem, which allows representing the energy of a signal as an infinite sum of small components corresponding to small segments of the frequency spectrum. The dependence of the length of that time interval between signal extrema on the bandwidth of the amplifier channel is evaluated on the basis of a distortion analysis of both signals upon passage through a low-pass filter, an elliptic filter being preferable to Butterworth, Chebyshev, and inverse Chebyshev filters with respect to minimum ripple of its amplitude-frequency characteristic as well as minimum delays and minimum width of the transition band. Figures 3; references 6.

UDC 621.396:621.391

Reliability of Quasi-Optimum Estimate of Phase Difference between Signals in Interferometer

907K0135D Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32, No 11, Nov 89 (manuscript received 12 Dec 88) pp 85-90

[Article by N. N. Klimenko and G. A. Semenova]

[Abstract] The estimate of phase differences between signals made by a quasi-optimum phase interferometer is analyzed for reliability, as an estimate of phase difference being regarded the discrete phase shift in the interferometer channel with the strongest output signals and reliability being measured in terms of probability. Calculating the probability of a reliable estimate requires determining the probability density distribution of interferometer output voltages based on the pattern of signal and noise passage through two interferometer channels with different levels of phase compensation. Calculations are made for a signal $s(t)= V\cos 2\pi f_0 t$ mixed with a Gaussian noise $n_1(t)$ in one channel and mixed with a Gaussian noise $n_2(t)$ in any of the N-1 other channels, both noises having zero mathematical expectations and identical autocorrelation functions $B([g|])= 2N_0 \sin\pi\Delta f t.\cos 2\pi f_0 \tau/\pi\tau$. First are calculated the output voltages of both multipliers, then the output voltages of both integrators and, with the aid of the Cauchy-Bunyakovskiy inequality, the cross-correlation function for these two voltages. The probability of a reliable phase-difference estimate is equal to 1/N times the sum of N-1 conditional probabilities that the voltage in the channel with the most nearly complete phase compensation is higher than the voltage in each other channel, each of the N-1 voltage differences being a normally distributed random quantity. For a given dispersion of the estimate there is an optimum number of channels with which such an interferometer will yield a maximally reliable estimate. This number of channels and the corresponding probability of a maximally reliable estimate have been calculated phase estimate dispersion of 5-30°. Figures 4; tables 1; references 3.

UDC 621.396.62

Superconductor Devices for Millimetric-Wave Receivers

907K0149A Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 12, Dec 89 (manuscript received 1 Nov 88) pp 2465-2483

[Article by A. N. Vystavkin, V. L. Koshelets, and G.A. Ovsyannikov]

[Abstract] Following a review of superconductor junctions, in particular resistive or more generally nonlinear resistive weak-link Josephson junctions and quasi-partially nonlinear tunnel junctions, three classes of superconductor devices sensitive to millimetric waves

are described with emphasis on those most recently developments but also including earlier ones and considering that their sensitivity to millimetric waves is determined by quantum fluctuations of the electromagnetic field. The first class covers square-law video detectors. Here belong Josephson SPJ (superconducting point junction) detectors featuring a high frequency resolution and quasi-partially nonlinear detectors with photon-aided tunneling characterized by a low leakage current and thus a low noise equivalent power. The latter include SIS (superconductor—insulator—superconductor) sandwiches, super-Schottky diodes, and Nb-Si-Nb thin-film Josephson junctions. The second class covers amplifiers. Parametric amplifiers include Josephson "four-photon" ones with pump frequency doubling, Josephson ones with self-pumping, and semiconductor-diode (Schottky-diode) amplifiers. Other amplifiers are masers (ruby), HEM (high electron mobility) FE (field effect) transistor amplifiers, and STJ (shunted tunnel junction) amplifiers such as the SQUID (superconductor quantum interferometer device). The third class covers mixers. Here belong SIS-sandwich mixers made entirely of refractory materials (Nb, NbN) with "artificial" tunnel barriers (Al_X O_y or Al_xO_yMgO) eminently suitable for radio astronomical receivers with characteristic superior to those of SIS mixers made of other materials (Pb alloys, Sn, Ta), SIN mixers, and superSchottky diodes. Another class of cryogenic devices are bolometers (InSb, In-Sb-Ge) for millimetric-wave and submillimetric-wave receivers. Discovery of metal-oxide high-temperature superconductor materials presents a major development, but the feasibility of their use in microwave receivers is still problematic owing to the mix of favorable and unfavorable characteristics. Figures 9; tables 4; references 105.

UDC 537.874.6.01

Grating of Dielectric Plates for Control of Electric Field

907K0149B Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 12, Dec 89 (manuscript received 12 May 88) pp 2505-2511

[Article by A. N. Morozov]

[Abstract] A uniform periodic grating of nonidentical lossless dielectric plates including a Floquet channel is considered for control of an electric field or electric lenses. Design and performance analysis of such a grating requires solution of the diffraction problem and the corresponding system of equations for coupled lines, a method being proposed which minimizes the dimensionality of this system by operating with a sparse matrix. The system of equations is obtained by the Bubnov-Galerkin method from the fundamental equation for natural modes in such a grating, only the TE-mode being considered here. This system of equations is solved for a grating of weakly coupled single-mode plates with both input and output matched to free space over a wide angular sector and within the allowable variation of parameters. It is solved by reduction to a system of algebraic equations and then numerically. The method applies to nonhomogeneous gratings of arbitrarily many plates, nonhomogeneous in terms of plate thickness and material (dielectric permittivity), to be designed for most efficient refraction of plane waves: 100% efficient when excited at the Bragg angle. Figures 4; references 7.

UDC 537.874.6.01

Black Bodies and Shadow Radiation

907K0149C Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 12, Dec 89 (manuscript received 30 Mar 88) pp 2519-2527

[Article by P. Ya. Ufimtsev]

[Abstract] Diffraction and scattering of waves by an opaque body much larger than the wavelength of incident radiation is analyzed on the basis of the Kirchhoff-Kotler model of a black body, of particular concern being radiation which enters the shadow region with a center beam forming behind such a body. The integral cross-section for scattering is defined on the basis of geometrical optics, according to which even an ideally absorptive coating will not reduce the power scattered by an ideally conducting body such as a metallic one to less then half, whereupon the shadow contour is defined as the boundary between the bright part and the dark part of the body's surface. The theorem already formulated and rigorously proved by the author in 1968, namely that the field scattered by a black body with a constant shadow contour is determined solely by this contour and does not depend on the shape of the body's surface, is now explained in physical terms on the basis of that black-body model. That field is then described in the asymptotic representation, the shadow region containing most of the near field so that the latter is an image of the incident one, and the field backscattered in the direction of the wave source is shown to be nonexistent. An analysis of the polarization characteristics reveals that the effective scattering area of a black body does not depend on the polarization of the incident wave. Numerical calculations on the basis of physical optics confirm that the black-body model does not really apply to absorbing opaque bodies but they indicate a contribution of radiation within their shadow region to the scattered field, this contribution depending on the shape of bodies which are large relative to the wavelength of incident radiation. Figures 5; references 11.

UDC 621.396.67.01

Iterative Algorithm of Two-Wave Phase-Difference Direction Finding

907K0149D Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 12, Dec 89 (manuscript received 21 Mar 89) pp 2528-2533

[Article by B. A. Khadzhi]

[Abstract] An iterative algorithm is constructed for simultaneous estimation of the azimuths of two narrow-band signals arriving at an equidistant circular antenna array, both signals having traveled in the plane of the antenna and the latter assumed to be horizontal. The space vector column representing the sum of both complex envelopes and additive noise is in each iteration split into two, hypothetically containing one signal only. From each vector-column is extracted the phase of the respective signal, the amplitudes of both being estimated in terms of maximum likelihood. The iterations are checked for convergence and, assuming a uniform isotropic surface noise field, Kramer-Rao estimates of the attendant fluctuation errors in the simultaneous estimates of two azimuths are made for the case of asymptotically low noise level. References 4.

UDC 621.396.962.4.01

Identification of Radio Pulse Signals with Unknown Structure in Multistation Radio Engineering Systems

907K0149E Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 12, Dec 89 (manuscript received 14 Nov 88) pp 2534-2538

[Article by A. F. Kotov]

[Abstract] An algorithm is constructed for identification of radio pulse signal by receivers in a multistation radio engineering system, this algo-rithm being applicable to a large class of radio pulse signals including phase-shift keyed ones with jumplike pseudorandom changes in parameters. It is assumed that m objects can, during a (0,T] period, send out pulse signals with structures of n different types, but that one object cannot send out simultaneously signals with different types of structure and that signals with the same type of structure cannot be sent out simultaneously more than one object. The states of the objects are characterized by mutually non-correlated M-dimensional Gaussian random vectors and the structures of signals arriving at the receivers not apriori known. The algorithm of signal identification reduces the problem to the equivalent one of object identification. The probability of erroneous signal identification can be estimated analytically, which is done for the case where the state vectors of the objects are known exactly. References 5.

UDC 621.396.96.01

Accuracy of Measurement of Radiation Source's Angular Coordinates

907K0149F Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 34, No 12, Dec 89 (manuscript received 3 Mar 89

[Article by V. Ye. Karakosyants, V. A. Loginov, and V. V. Slonov]

[Abstract] The problem of determining the angular coordinates of a radiation source is reduced to locating the energetic center of gravity of the source's image. The algorithm of estimating the angular coordinates of a source from the energetic center of gravity of its image is analyzed for accuracy of such estimates, taking into account not only the randomness of the coordinates and of the signal parameters but also regular and parasitic space-time modulation of signals along their paths through a randomly nonhomogeneous medium as well as background noise and the sensitivity of optical instruments such as an optical radar to skylight. The dispersion of the estimation error at various signal-to-noise ratios is calculated for two optical using a wide optical filters and having, in terms of numbers of phase-fluctuations correlation spots and signal field coherence spots, a "small" aperture and a "large" aperture respectively. The accuracy of estimates based on this algorithm is compared with the maximum attainable one, namely that of maximum-likelihood estimates based on all accessible apriori information. Tables 2; references 5.

All-Union Conference on Current Problems in Development and Introduction of New Information Technology

907K0136F Moscow RADIOTEKHNIKA in Russian No 11, Nov 89 pp 111-112

[Article by G. S. Lantsberg, Chairman, 'Scientific and Technical Information' Section, Central Board, All-Union Scientific and Technical Society of Radio Engineers and Electrical Communications imeni A.S. Popov]

[Abstract] An All-Union Conference on Current Problems in Development and Introduction of New Information Technology was held on 29-31 March 1989 in Tallinn. It was organized by the Popov Society's Section for Scientific and Technical Information, the Institute of Radio Engineering at the USSR Academy of Sciences, the Academy's Council on Automation of Scientific Research jointly with the All-Union Scientific Research Institute of Interdepartmental Information Exchange, and the All-Union Institute of Scientific and Technical Information, also the Estonian Scientific Research Institute of Scientific and Technical Information and Engineering Economics Research at the ESSR State Planning Committee, and the the Popov Society's Estonian Regional Board. Over 200 participants from over 30 cities in the USSR, leading information and computer

scientists and specialists, participated in topical "round table" sessions covering five major areas: 1) socioeconomic aspects of "informatization", 2) general methodological problems, 3) governmental information system under new economic conditions, 4) intelligent information systems, 5) information systems and processes. A strategy has been devised at the conference for dealing with development and introduction of new information technology so as to meet current problems and requirements, "informatization" meaning creation for Soviet society an informational infrastructure by computerization of all accessible data banks and with the aid of modern communication facilities, an informational infrastructure adequate for solving major problems in political, social, economic, and ecological restructurization ("perestroyka"). This was found to require not only socioeconomic but also morale and cultural studies, doing away with the parochial approach and isolationism as well as with monopolization of information by individual departments, a modern method of informational support, legal and economic bases for information-related activity, strategic information-analytical research, enhancement of the information users' knowledge, a network of data analysis centers, extensive use of local, regional, and national information networks, their eventual integration into a global one, broad implementation of cost analysis and accounting methods, radical modernization of the equipment available to all members of the automated State System of Scientific and Technical Information, concentrated efforts by scientific research institutions, design offices, and industrial enterprises toward series production of modern reliable hardware including personal equipment, maximum utilization of the facilities available in the armaments industry, and finally establishment of either one nationwide higher educational institution or several departments at existing ones for the special purpose of training information scientists and engineers.

UDC 621.385.832.82

High-Resolution CRT's and Their Application

907K0196A Moscow ELEKTRONNO-LUCHEVYYE TRUBKI VYSOKOY RAZRESHCHAYUSHCHEY SPOSOBNOSTI I IKH PRIMENENIYE in Russian Book 1989 pp 2-4

[Annotation, foreword and table of contents from book by Z. D. Gritskiy]

[Text] Annotation

The book examines high-resolution CRT widely used in various I/O devices and information processing equipment. It presents problems of developing focusing-deflecting complexes, describes methods and equipment for measuring CRT parameters and characteristics and gives examples of CRT applications in various devices.

The book is aimed at the engineering and technical personnel involved in design and operation of information I/O devices.

Foreword

High-resolution CRT (HR CRT) have a special place among numerous types of cathode-ray devices. Literature also calls them tubes with a microspot, ultrahigh-resolution tubes, or precision tubes, and puts in this category devices in which the diameter of the emitting spot does not exceed 100 mcm and is mainly in the 10-30 mcm range, and the number of decomposition elements per screen line is 2,000-10,000 or more.

High resolution can only be realized if HR CRT external devices are made properly. These devices can be divided into two groups—focusing-deflecting complexes, and power supply, control and correction electronic circuits. The former include electromagnetic optoelectronic elements, adjusting and mounting devices for them, and elements that protect from external noise-carrying fields; the latter include precision power supply devices for CRT electrodes and electromagnetic elements of focusing-deflecting complexes, beam deflection control devices, and distortion correction circuits.

Due to high information capacity of the screen, high speed and control flexibility, HR CRT are widely used in a large number of various purpose devices, especially because of the development of digital computer technology, where they are used as an efficient type of information I/O devices. Among them are image recognition and digital processing devices, scanning and measuring devices for film information processing, electronic phototypesetting machines, computer-to-film information output devices, devices for dynamic display of public-use information etc. Continuous improvement of all main parameters of HR CRT determines future prospects for their applications in various fields.

High resolution and tight distortion tolerances make it necessary to develop and use special methods for and means of measuring HR CRT parameters and characteristics.

These problems have been basically covered in individual papers and sections of a few monographs.

The book's objective is to summarize available data on HR CRT and specific features of their application. It is the author's opinion that this could facilitate improvement of the effectiveness of operation of existing and development of new systems. Problems discussed in the book are to a certain degree close to fields such as electronic microscopy, electron beam material treatment, electron beam litography and CRT information display.

The limited size of the book has not made it possible to discuss equally comprehensively all problems covered here. Because of this, the author has deemed it necessary to present a fairly detailed list of known works. Due to the same reason, most formulas are given without derivations.

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UDC 621.382.8.001.2:519.2

Analysis of Production Yield of Acceptable IC Devices Taking into Account Distribution of Circuit Parameters over Wafer

907K0113A Moscow MIKROELEKTRONIKA in Russian Vol 18, No 6, Nov-Dec 89 (manuscript received 16 Feb 88) pp 509-514

[Article by V. Ye. Vlasov, I. A. Lubashevskiy, and V. V. Pishchayev]

[Abstract] In accordance with the acceptability criterion for IC devices in terms of tolerance limits on their parameters, a mathematical model is constructed which will serve as basis for analysis of their production yield andwill take into account the distribution of circuit parameters over the wafer surface as well as the correlation between them. The distribution of parameter values is described as a smoothly varying function of space coordinates, its form depending firstly on the IC fabrication technology and secondly on the random deviations of circuit parameters from nominal values caused by inevitable nonhomogeneity of individual circuit components. The actual value of each parameter is accordingly expressed as the sum of two parts, a gradiental one with a characteristic scale of variation much larger than the dimensions of a given circuit component and a "noise" part representing independent variations of parameters within a given circuit component. The yield of acceptable IC devices is then calculated statistically first for the extreme case of a correlation radius r much shorter than the linear chip dimension L and then, assuming a uniform packing density, for the other extreme case of a correlation radius r longer than or almost as short as the linear chip dimension L. In this case there are again considered two extreme cases: $(Y_{i,max} - Y_{i,min} - 2\Lambda_i)\log N/\Lambda_i$ much larger than 1 and much smaller than -1 respectively (Y - value of i-th parameter of n-th circuit element, N - number of independent regions in chip approximately equal to L^2/r^2, $\Lambda_i = (2a_{ii}\log N)^{1/2}$, a_{ii} - diagonal element of correlation matrix assumed not to fluctuate and not to vary in space). The two gradiental and "noise" parts of a parameter value must not necessarily fall into the same extreme case and the tolerance field must not necessarily be a rectangular one. Figures 2; references 7.

UDC 621.382.8.001.4

Optimum Structure of Interface between Test-Sequence Generator and Diagnostically Tested Circuit

907K0113B Moscow MIKROELEKTRONIKA in Russian Vol 18, No 6, Nov-Dec 89 (manuscript received 15 Oct 88) pp 549-553

[Article by M. K. Akylbayev, Institute of Microelectronics, USSR Academy of Sciences]

[Abstract] Generators of pseudorandom sequences with excellent statistical characteristics have been developed for fault detection in LSI and VLSI circuits, but a special test method is required to ensure a that no faults remain undetected. This can be achieved by "exhaustive testing" according to O.T. Tang and C.-L. Chen (IEEE TRANS.: COMPUTERS Vol C-33, No 9, 1984), namely by applying to circuit component with k inputs as many as 2^k sequences of 0 and 1 so as to exhaust all possible k symbols long sequences of 0 and 1. The procedure is elucidated on testing of a circuit with n inputs, the signals which appear at each of its output depending on the signals which have been applied to k of its inputs. Considering that a set of n-dimensional vectors in a binary n-dimensional space which constitutes the rows of a matrix A does completely cover the subspace formed by k columns of this matrix if projecting this matrix on that subspace will yield 2^k different projections, the validating theorem stating that complete coverage of such a subspace requires linear independence of its columns is proved by reductio ad absurdum. The algorithm of exhaustive testing is constructed on that basis, for testing with a linear shift register of length r as generator of pseudorandom sequences. An irreducible primitive polynomial g(x) of k-th or higher degree m describing the feedbacks is selected for testing circuit components with k inputs. The algorithm is programmed so as to include search for the optimum generator—circuit interface as well as checking the matrix for rank and linearly independent columns. It is demonstrated on a specific example: $g(x) = x^3 + x + 1$, k=m= 3, r= 9, and an 8x8 code matrix A. Figures 3; references 8.

UDC 621.039.5

Viewing Immunological Mechanisms from Standpoint of Radioelectronics

907K0099A Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 32, No 10, Oct 89 (manuscript received 23 May 88) pp 4-14

[Article by M. B. Golant]

[Abstract] Immunology is viewed in terms of radioelectronics so as to facilitate the understanding of biophysical mechanisms which protect the body with utmost economy of energy and material. First are considered coherent acoustoelectric vibrations which body cells generate, their natural frequencies covering the shortwave range within which molecules of most albumins resonate while both frequency and phase locking of their vibrations are dependent on the adhesive coupling between the molecules and the cell membrane. Following a review of immunological concepts and terms (antigens, antibodies, cellular and humoral responses, presentation), four problems of immunology are discussed and then explained from that standpoint of vibration spectrum theory: 1) what makes cells of the organism's immunity system perceive the frequency spectrum of an antigen, 2) what determines the exponential buildup of antibodies at various stages of the immune response and the cessation of their buildup upon disappearance of an antigen, 3) what makes macrophages able to absorb and convert any antigen other than their own, 4) what brings about immunologic tolerance and to what is the dependence of antigen properties on the molecular mass attributable. References 16.

UDC 621.372.822

Selection of Transmission Line for Millimetric-Wave Operation

907K0099B Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 32, No 10, Oct 89 (manuscript received 1 Apr 88) pp 67-72

[Article by V. I. Kazantsev and A. I. Kharitonov]

[Abstract] A systematic survey of ten common types of EHF waveguides, including their basic design and performance characteristics, indicates that none of them can meet all requirements and that there is no one which can serve as a universal transmission line for all applications. The selection of a transmission line for any given application must, therefore, be based on the most essential requirements only. Applications for EHF waveguides are, accordingly, classified into four principal areas and the types of waveguide most suitable for each are then identified. For high-power feeders select coaxial or metal-dielectric transmission lines. For long wideband channels select coaxial transmission lines. For consumer equipment select waveguide-slot, image-slot, guarding, dielectric-rod, or microstrip transmission lines. For test stands and measuring instruments select coaxial or metal-dielectric transmission lines. For some applications may be selected standard rectangular, oversize rectangular, circular H_{01}-mode, or cylindrical-slot wave-guides. Figures 1; tables 1.

UDC 621.826.621.317

Interferometers with High Thermal Stability and Vibration Resistance

907K0096A Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 89 pp 18-19

[Article by A. L. Starkov]

[Abstract] The author has developed and patented two laser interferometers featuring both high thermal stability and vibration resistance. The first one is a two-beam Michelson interferometer with a movable reflector rigidly coupled to the moving object. Its unusual feature is a beam splitter, a truncated right prism with a translucent reflective coating on the base surface, serving as reference mirror and identical to the movable one. The second interferometer is twice as sensitive, its unusual feature being a monolithic beam splitter in the form of a right parallelepiped and dihedral movable mirror. Its beam splitter has four optical faces, with a translucent over half of the front face and a specular coating over three quarters of the other one of the two parallel faces. Both interferometers are mechanically sturdy and small in size, not easily detuned but easily aligned. They contain the minimum of optical components and surfaces, which contributes to their high reliability. Figures 2; references 5.

UDC 681.833

Thermoanemometer for Measuring Velocity of Gas Streams

907K0096B Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 89 pp 26-27

[Article by V. A. Bukevich and M. N. Rozenvasser]

[Abstract] A thermoanemometer for measuring the velocity of gas streams is described which includes thermostatic control with a thermistor probe in the control loop, the power dissipated by this probe depending on both velocity and temperature of the gas stream. Another thermistor under the sheath of this probe responds to change in temperature only. The instrument was tested in a wind tunnel, with the velocity varied over the 0.5-15 m/s range and the temperature varied over the 10-40°C range, for acquisition of experimental data on the basis of which the mathematical model of such a transducer can be empirically simplified by polynomial approximations of its voltage-velocity and voltage-temperature characteristics: $V_v = (k_1 t + k_2)v^n + k_3 t + k_4$ and $V_t = k_5 t + k_6$ (v - velocity, t - temperature). The electrical components of the thermoanemometer include these two hermetically sealed thermistors, five operational amplifiers, two operational dividers, and a stabilized solid-state power supply built on a field-effect transistor. The amplifiers, including a voltage difference amplifier (velocity signal minus temperature signal) are built on 140UD14 microcircuit chips. The dividers are built on 525PS2 microcircuit chips. Tuning the thermoanemometer is done with a special device in three steps: by tuning its thermal compensation circuit first at zero air velocity and then at a near maximum air velocity, finally by adjusting the raise-to-power-n circuit. An aerodynamic device with two nozzles was used for calibrating the thermoanemometer so that its reading error did not exceed 5%. Figures 2; references 5.

UDC 621.317.789.082

Experience in Reception of Precise-Time and Standard-Frequency Signals in Eastern Kazakhstan

907K0096C Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 89 p 28

[Article by N. I. Olinichenko]

[Abstract] The problem of checking equipment which contains high-precision quartz reference oscillators with a nominal frequency error not larger than $+/-10^{-6}$-10^{-4}% and have been installed in remote regions such as Eastern Kazakhstan is discussed, a major difficulty being lack of special equipment for transporting frequency standards over long distances under poor road conditions. Regular checking of radio station equipment against high-precision standards kept elsewhere over communication channels was tried experimentally during the 1986-88 period, reception of 25 kHz signals and later of 40-50-66.6-90 kHz signals from frequency standards being evaluated for fidelity. The results of this study indicate that radio stations farther east should be converted to operation lower rather than higher frequency channel. There is not much literature available on this subject. References 2.

UDC 534.620.087.92:681.7.068

Fiber-Optic Mirror-Type Acoustic Transducer

907K0096D Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 89 pp 47-48

[Article by Ye. S. Avdoshin]

[Abstract] A fiber-optic mirror-type acoustic transducer is described which consists of two optical fibers terminating into a lens each inside a sleeve, one guiding the light into a cup covered by a reflecting membrane and one guiding light out of it. The sleeves of the two light guides are inserted into cup through holes in the bottom, at a 40° angle to one another and at a 70° angle each to the 80 μm thick acoustic polymer membrane stretched above them across the cup. The membrane, 40 mm in diameter, is glued to a gasket around the rim of the cup. To the bottom of the cup, between the two light guides, is glued a rectangular mirror facing the membrane. The latter is on the side facing that mirror coated with a 1 μm thick reflective film acting as a second mirror (reflection coefficient 0.98) so that multiple reflections of light occur between entrance to and exit from the transducer cavity. Both optical fibers are 0.5 m long multimode quartz fibers with a numerical aperture of 0.2, their cores being 50 μm in diameter and their sheaths being

125 μm in diameter. Deflection of the transducer membrane by sound pressure alters its distance from the bottom mirror and thus also thelight path inside the transducer cavity. Consequently, the the laser beam leaving the cavity through the second fiber will impinge on a p-i-n photodetector diode will at various locations. The thus modulated luminous flux is thus converted into an alternating electric signal. The mechanism is demonstrated mathematically for a sinusoidally varying sound pressure and correspondingly varying membrane-to-mirror distance. Ripple noise is also accounted for in the performance analysis of this transducer. Figures 1; references 4.

UDC 621.386.8.084.873:539.1.074

Factors Influencing Stability of Radiometric Characteristics of X-Ray Scintillation Detectors

907K0096E Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 89 pp 50-52

[Article by M. Ye. Globus, L. B. Zagariy, and Yu.A. Tsirlin]

[Abstract] For a stability analysis of scintillation detectors operating under a fluctuating high voltage, factors influencing the flat range of their performance characteristic which corresponds to a weak voltage dependence of the counting rate. First is calculated the differential spectrum of pulses at the photomultiplier input, this spectrum consisting of an approximately exponential noise component and a Gaussian photoconduction peak. Next is calculated the integral counting characteristic, considering that the right-hand corner of the flat range lies within the left-hand "tail" of the photoconduction peak. The width of the voltage range over which the counting rate remains nearly constant flat range is found to depend on the signal-to-noise ratio, on the luminous output and the energy resolution of the photodetector, on the type of photomultiplier and the number of diodes, and on the tolerance range for counting rate instability. The theoretical relations are correlated with experimental data, 5.9 keV x-radiation quanta from a ^{55}Fe source having been recorded by an NaI(Tl) crystal with an FEU-35 (8 diodes) or FEU-37 (11 diodes) photomultiplier and measured with a PD-2.1 integral-differential analyzer. Figures 2; references 5.

UDC 681.325:621.376

Estimating Parameters of Compound Signals in Coherent Optical Systems

907K0100B Moscow IZMERITELNAYA TEKHNIKA in Russian No 10, Oct 89 pp 14-16

[Article by V. I. Shcherbak]

[Abstract] Synthesis of coherent optical instruments for measuring multidimensional vectors of parameter data is considered, such instruments usually operating with compound test signals and such signals being formed by n elementary waves coming each from one of n spatially related sources. Spatial relation is defined as as a known constant quantity which determines the structure of a compound signal, this being the angle between paired wave vectors for waves with plane phase fronts and the distance between paired sources for waves with spherical phase fronts. For each pair of sources of waves with spherical phase fronts there are three spatial relations: 1) angle between axes of phase front cylinders in the plane in which signals are processed, 2) difference between the sloping angles of these axes relative to that plane, 3) distance between the centers of sources. It is furthermore assumed that the instrument receives an approximately additive mixture of a deterministic compound signal and a white noise characterized by its spectral density. The instrument must estimate the parameters of the incoming signal, for which an optimum algorithm is constructed which yields an estimate of any component of the data vector representing the phase parameter. The estimation algorithm utilizes the concept of an elementary channel for spatial processing of data, a device which integrates over the surface of spatial averaging. The necessary number of channels is equal $N_p = nl - b_p$ (l - dimensionality of the data vector, b - number of spatial relations, p= 1 for plane waves, p= 2 for spherical waves, p= 3 for cylindrical waves. As the number of sources n increases, N_p first increases and then decreases. Exceeding a certain maximum number of channels, therefore, will not yield more useful data about a compound signal. An instrument has been synthesized according to this algorithm with six channels for spatial processing and a computer processor for calculating associated parameters not directly estimated but obtainable from the estimated ones. Each channels includes two multipliers realizable holographically and a spatial integrator realizable, for instance, with a focusing lens and a photodetector. Figures 2; references 3.

UDC 621.083.8:535.215

Method of Calculating Parameters of Pulsed Photoelectric Transducer with Several Optron Pairs

907K0100C Moscow IZMERITELNAYA TEKHNIKA in Russian No 10, Oct 89 pp 16-17

[Article by L. I. Sokolik]

[Abstract] A photoelectric transducer with several optron pairs is considered for operation with periodic pulse sequences, an optron pair comprising a source of visible or invisible light and a photodetector. It includes either a rotating disk with a circular array of holes for each optron pair or one common disk for all optron pairs with circular array of holes or slots for each. Simple relations are established for the design of such a transducer, namely for calculating the necessary difference Δ between the pitch of optron pairs and the pitch of holes in the disk (disks) for a given number of distinctly separate pulses per revolution of the disk (disks) with adequately long intervals between them, then calculating the necessary numbers of optron pairs and holes or slots,

also the pitches of optron pairs $H_{\alpha=\ KH\ \theta}$ +/- Δ (K - positive integer, α - linear dimension of light beam cross-section or optron diaphragm and θ - linear dimension of hole or slot along circle through the optron axis). The design procedure is illustrated by a numerical example. Figures 2; references 2.

UDC 681.2.088:535.23

Instrument Transducer for Standard of High Energy Levels in Laser Radiation Pulses

907K0100D Moscow IZMERITELNAYA TEKHNIKA in Russian No 10, Oct 89 pp 17-18

[Article by B. M. Abakumov, L. P. Buyko, A. S. Ilin, G. L. Kabanov, and G. Ye. Pavlova]

[Abstract] The instrument transducer for the BET 112.3-83 reference standard of high energy levels (0.5-5.0 J) in 0.5-1.5 s of 10.6 μm laser (CO_2) radiation is described, a laser beam not thinner than 5 mm in diameter with a not higher than 25 W/cm^2 power density being reflected by a diffractional attenuator over the duration of a pulse. The sensing element of this transducer is a 1 mm thick copper disk 40 mm in diameter, soldered to a temperature equalizing copper cone on the surface of which along a generatrix are mounted through an insulating strip four Cu-Constantan thermocouples in Textolite-glass cases. A coating of AK-243 enamel with a 30 W/cm^2 rating on the outside surface of the copper disk ensures a high absorption coefficient. The overall thermal capacity of this sensor, without a passive thermostat, is 10 J/K and its integral thermal conductivity is 0.15-0.2 W/K. Drift of the dark signal is prevented by connecting two identical sensors differentially. Certification testing of this transducer was done with the State Special Energy Standard (SSEE) for laser radiation. The r.m.s. error of the transducer (0.45% maximum) is equal to the square root of the square of the random SSEE error (0.2%) plus one third of the sum of the squares of five nonremovable systematic errors, four of them being due to dependence of the conversion factor on the location of laser beam incidence (0.5% maximum), on the measured energy level within the 0.5-5.0 J range (0.4% maximum), on the ambient temperature within the 18-22°C range (0.35% maximum), and on the pulse duration within the 0.5-1.5 s range (0.11% maximum), and one of them being the nonremovable systematic SSEE error (0.1%). Figures 1; references 3.

UDC 535.361

Pulsed Light Source in Submersible Instrument for Measuring Hydrooptical Characteristics

907K0100E Moscow IZMERITELNAYA TEKHNIKA in Russian No 10, Oct 89 pp 18-20

[Article by Ye. Ya. Kuznetsov and V. V. Kudryavtsev]

[Abstract] A high-intensity pulsed light source for deep underwater measurement of hydrooptical characteristics, namely attenuation and scattering coefficients, has been developed on the basis of DKsSh-150a gas-discharge flash lamp. The luminaire inside submersible hermetic enclosure is wrapped in a heat dissipating blanket with three windows. To light beams are emitted through the two windows on opposite sides of the luminaire, each one passing through a lens which focuses it on a diaphragm and then from the diaphragm to another lens which collimates it for exit through a porthole in the housing. In the water, outside one porthole at a 10-20 mm distance from it, is placed a Porro prism which reflects the reference light beam back through the port-hole into the luminaire housing. On the other side there are three portholes and for the main light beam and another Porro prism placed outside farther away so as to allow sufficient space for instrumentation in the water. Two plane mirrors inside the luminaire housing deflect the light beams returning through the portholes at right angles away from the lamp toward three photodetectors, one photodetector for a control beam tapped off the main light beam. The photodetectors are followed by amplifiers which send signals to corresponding synchronous detectors mounted together with a synchronizer on a control panel outside the luminaire housing. Light flashes in the lamp are triggered by high-voltage internal-ignition pulses from a power supply also located inside the luminaire housing. The lamp generates flashes of 0.45 J luminous energy and 300 μs duration (flash power 1.5 kW) at repetition rates of 0.1-30 Hz, with an amplitude instability not exceeding 20% over an 8 h period of continuous operation. The lamp draws a current of 0.05-0.7 A, depending on the flash repetition rate. Figures 2; references 4.

UDC 621.314.2.027.9.621.374

High-Voltage Power Pulse Transformer with Single-Turn Primary

907K0098A Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 89 (manuscript received 12 Dec 88) pp 58-62

[Article by S. S. Vdovin, doctor of technical sciences, professor, Dnepropetrovsk State University]

[Abstract] A transformer with a single-turn primary delivering high-voltage power pulse trains from its secondary is described, a core-type transformer with a toroidal magnetic core immersed in oil between the inner tube and the outer tube of a cylindrical tank. Both tubes as well as the bottom plate and the cover plate are all made of electrical-grade aluminum to form the single-turn primary, a gasket-seal insulating the cover plate from the flange of the outer tube. The magnetic core is mounted above the bottom plate on a symmetrically spaced pair of supports. The secondary consists of three or four identical windings connected in parallel with a center tap and held in place by inserts made of acrylic glass. The primary voltage coming from separate and independent generator sets through artificial shaping lines is applied between cover plate and outer tube, at symmetrically spaced points around the periphery. In the single-turn primary acts as an energy summator. Both design and performance of such a transformer are analyzed on the basis of conventional theory, some possible configurations are shown and typical numerical performance data are given in per-unit values. Figures 4; tables 3; references 8.

Steady Heating of SF_6-Filled Circuit Breakers

907K0098B Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 89 (manuscript received 14 Dec 88) pp 62-64

[Article by A. V. Vedernikov, engineer, and A.V. Skurikhin, engineer, Scientific Research Institute of Scientific-Industrial Association 'Uralelektrotyazhmash' (Ural Heavy Electrical Machinery)]

[Abstract] An experimental study of SF_6-filled 330-500-750 kV circuit breakers with nominal 3.15 kA current carrying capacity and nominal 40-kA or 63 kA current breaking capacity was made, for an evaluation of their steady-state heating characteristics as a key factor influencing the design of their current-carrying component. Three parameters were varied: load current I from 0 to 4 kA, resistance of the make-before-break contact from 2.7 to 10.3 μΩ, and gas pressure P over the 0.1-0.6 MPa range. The resistance of the opening contact was set at 2.2 μΩ and at 3.1 μΩ. The temperatures of the tabs of both contacts were measured with Chromel-Copel thermocouples 9-10 h after current had been switched on and the temperatures had stabilized. The data reveal the distribution of the temperature rise along the contact tabs and its strong dependence on the resistance of the make-before-break contact. They also indicate that the temperature rise at any point is proportional to $I^{1.73}$ and inversely proportional to $P^{0.21}$. A mathematical model of steady heating in such circuit breakers has been constructed on this basis and programmed in FORTRAN for computer-aided iterative design analysis, the calculation process being terminated when two successive iterations have yielded temperature rises differing by not more than 0.1°C. Increasing the cross-section of the stationary parts by 10-20% was found to allow raising the nominal rating of the entire current-carrying component of such circuit breakers to 4 kA without a major redesign. Figures 4; references 6.

UDC 621.374.001.5

Using Epoxy-Glass Tubes in Support Structures for Voltage and Current Pulse Generators

907K0098C Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 89 (manuscript received 3 Jun 88) pp 65-68

[Article by V. Ye. Batrak, engineer, T. V. Kondakova, engineer, R. T. Osnach, engineer, and Ye. N. Chernov, engineer, All-Union Institute of Electrical Engineering imeni V.I. Lenin, Istra branch]

[Abstract] An experimental study of epoxy-glass tubes used in support structures for voltage and current pulse generators was made, these tubes providing electrical insulation as well as mechanical support. The tubes were made of ED-20 epoxy-diane resin with MHP-9 plasticizer and iso-MTHPA hardener reinforced by RBN-13-2520-47 glass roving wound at +54° and -54° angles to the axis so as to ensure equality of strength under both longitudinal and circumferential components of internal pressure. Also epoxy-glass tubes with "Sispur" polyurethane foam filler were tested, for a comparative evaluation of both materials. Tests were performed in accordance with applicable standards. Electrical tests were performed with d.c. voltage built up at a rate of 2 kV/s, with 100/2000 μs switching pulses whose amplitude matched a 50% probability of flashover, and for "life" under a 50 kV d.c voltage of negative polarity at 288-298 K temperature and 96-100

relative humidity. Static mechanical tests were performed for determination of strength under tension, compression, and torsion loads. Dynamic mechanical tests were performed for determination of the fatigue limit on the basis of 2×10^6 cycles under compression loads varying sinusoidally at a frequency of 10 Hz, sufficiently low for avoidance of appreciable heating, with 0.5 and 0.8 cycle asymmetry (ratio of minimum to maximum stress). The data, plotted in the form of S-N diagrams, reveal that the fatigue limit becomes higher as this ratio approaches unity and the load thus approaches a static one. The results indicate that porcelain may be replaced with epoxy-glass as material for insulator. Figures 3; tables 3; references 5.

UDC [621.373:621.311].001.4

Generators of Current Pulses with Shape Control for Pumping Technological Lasers

907K0098D Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 89 (manuscript received 2 Nov 88) pp 68-72

[Article by V. M. Opre, candidate of technical sciences, Leningrad Institute of Electrical Engineering]

[Abstract] Generators of current pulses with homogeneous artificial lines for pulse shape control are considered for pumping technological lasers, especially lasers used for welding and for hardening by heat treatment, the advantages of such lines including compatibility with the generatordesign as well as their excellent pulse shaping characteristics. Such a line contains switches which are controlled so that the capacitors can be charged to various controllable levels. For an analysis of electromagnetic process in such an artificial line, a line with lumped parameters, an equivalent to it long line with distributed parameters is considered first. The latter is then broken up into segments, whereupon each segment is replaced with a lumped inductance and a lumped capacitance. The analysis of transients is based on a theorem which relates the shape of current pulses i(t) in a matched linear resistance load across a homogeneous line with distributed parameters to the shape of discharge voltage pulses v(x). Generating square current pulses can now be treated as a special case of the general design problem. Figures 4; references 7.

UDC 621.311.004.13

Method of Determining Margin of Static Stability in Complex Electrical Systems

907K0139A Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 89 (manuscript received 29 Jun 88) pp 7-12

[Article by V. Z. Manusov, doctor of technical sciences, professor, S. M. Moiseyev, candidate of technical sciences, and L. V. Tolstikhina, engineer, Novosibirsk Institute of Electrical Engineering]

[Abstract] One problem in the design of electrical power systems for ever increasing load capacity, namely ensuring retention of static aperiodic stability, is reduced to determination of the stability margin, i.e., the nearest distance of the operating point from the stability limit. It is formulated in terms of a circular rather than linear trajectory of the operating point. The n-dimensional system of equations W(X,Y)= 0 describing steady-state operation (X - vector of fixed parameters, Y - vector of adjustable parameters) and the equation JS= 0 (Jacobi matrix J= δW/δX, S - eigenvector of Jacobi matrix) are accordingly supplemented with the equation F(Y)= 0 of a circular trajectory. The thus expanded system of equations is solved by Newton's method, after it has been linearized for each iteration. It is first solved for an electric power system with two adjustable parameters, in which case the system of linearized equations is of a dimensionality almost four times the dimensionality of the system of Kirchhoff's equations. It is then solved for an electric power system with m adjustable parameters, typically a delta network with resistive-inductive branches connecting its three nodes, in which case the system of equations becomes an mX(2n+ 1)-dimensional one. Article submitted by Department of Electrical Power Supply for Industrial Enterprises. Figures 2; references 7.

UDC 621.316.542.054

Method of Plotting Life Characteristics of High-Voltage Circuit Breakers

907K0139C Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY; ENERGETIKA in Russian No 11, Nov 89 (manuscript received 18 Apr 87) pp 39-42

[Article by V. V. Grabko, engineer, and B. I. Mokin, doctor of technical sciences, professor, Vinnitsa Polytechnic Institute]

[Abstract] A method of plotting the life-current characteristics of high-voltage air circuit breakers is proposed, every such device being now equipped with a counter which indicates how many more tripping operations it will still be able to perform. Considering that tabulated data lie on a curve which resembles but is not a hyperbola, the gist of the method is to hyperbolically normalize those data relative to the largest of the nI products and then to approximate the normalized inverse function 1/n* with a complete power polynomial in the normalized current I* plus a constant term, the degree and the coefficients of this polynomial being determined by the method of least squares and A.G. Ivakhnenko's outer-values test using the concept of "new" points. Figures 2; tables 2; references 5.

UDC 681.7.068:621.396.2

Transmission of Signals at 1.2 Gbit/s over Optical Cable

907K0120A Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 33, No 10, Oct 89 (manuscript received 29 Sep 88) pp 881-883

[Article by Ya. V. Alishev and A. A. Marenkov, Minsk Institute of Radio Engineering]

[Abstract] A single-mode fiber-optic communication system has been developed for high-speed data exchange between computers at a rate of 1.2 Gbit/s, both transmitter and receiver combining a compact and highly standardized construction with highly reliable and stable operation. Normal operation of the semiconductor laser during temperature fluctuations and under adverse conditions is ensured by two stabilization systems. One with a large time constant stabilizes the threshold current by regulating the bias current and thus maintaining a constant average emission power. One with a small time constant automatically regulates the amplitude of the radiation modulating signal. The high-frequency component of the modulator is built with AP602G Schottky-barrier field-effect GaSAs transistors. The receiver, a transimpedance amplifier, is built with Ge avalanche photodiodes. A theoretical design and performance analysis of such a communication system operating with a 1.3 μm laser (5 nm wide emission line) and a conventional threshold device line indicates the feasibility of transmitting up to 1.2 Gbits per second over a 50 km long distance without repeaters, assuming a 3 ps/(nm.km) dispersion and a 0.5 dB/km attenuation. A resolver with quantum feedback will extend the range by additional 15 km while allowing 70% more distortion in the cable. These estimates have been confirmed by experimental studies of such a communication system. Article was presented by Academician V.A. Labunov, BSSR Academy of Sciences. Figures 2; references 4.

UDC 535.42

Effect of Gyrotropy on Mutual Transformation of Electromagnetic Waves in Cubic Photorefractive Crystals

907K0120B Minsk DOKLADY AKADEMII NAUK SSSR in Russian Vol 33, No 10, Oct 89 (manuscript received 16 Nov 88) pp 884-887

[Article by V. V. Shepelevich and Ye. M. Khramovich, Mozyr State Pedagogical Institute imeni N.K. Krupskaya]

[Abstract] Mutual transformation of electromagnetic waves in a thick translucent holographic phase grating recorded in a cubic photorefractive crystal with an arbitrary orientation of the grating vector K is analyzed, with the gyrotropy of such crystals ($Bi_{12}SiO_{20}$, $Bi_{12}GeO_{20}$, $Bi_{12}TiO_{20}$) taken into account and with light of a color to which the crystal is insensitive selected for reconstruction so as to eliminate the possibility of postrecording. Absorption of light by the crystal and the piezoelectric effect are ignored, as are also effects of optical activity during recording along with electrogyration and diffractional gyration. The nonuniform charge distribution which forms in the interaction space during recording is assumed to give rise to an internal electric field which alternates in space with a certain vector amplitude and modulates the dielectric permittivity of the crystal. The system of scalar differential equations for the complex vector amplitudes of both reference and object waves inside the crystal is formulated in the Kogelnik approximation with gyrotropy accounted for. It is solved for the typical geometry of an experiment: a holographic phase grating in a (110) crystal cut and the two waves symmetrically incident in a plane normal to it. The solution reveals an intensity redistribution between the two waves during their interference, the resulting intensity of each depending largely on the optical activity of the crystal and on the orientation of the grating. In the case of a grating vector parallel to the[11(dash)1] plane, while a polarization transfer occurs, the intensity of each wave after interference depends also on their azimuths. In reconstruction of images from holograms recorded by the Huignard-Aubourg method it is thus possible to maximize the signal-to-noise ratio by proper polarization of the reconstructing light wave. Article was presented by Academician B.V. Bokut, BSSR Academy of Sciences. Figures 1; references 10.

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